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ROUTE SECURITY FOR COUNTERINSURGENTS

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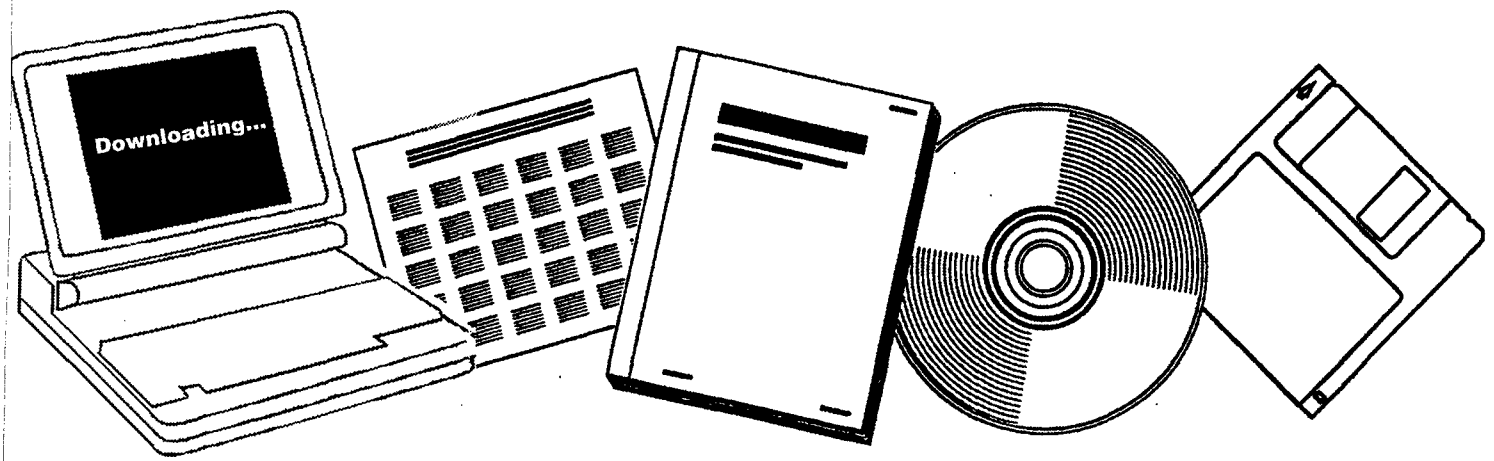

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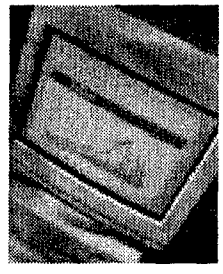

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by

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

The problem of providing security for ground lines of communications in the counterinsurgency environment is examined. Several types of forces and modes of employment are considered and analyzed in order to determine their feasibility and desirability. Recommendations are made for resource allocation in areas which have different insurgent threat levels. Some economic and political factors which affect route security are mentioned.

A comparison, using Lanchester's equations, is made of the reaction and escort modes of employment for infantry forces providing security to a truck convoy. Graphs are provided which show the effects of time on reaction force feasibility.

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The author wishes to express his deep appreciation to Professor G. F. Lindsay, who provided a great deal of insight and guidance throughout the entire effort; to Mr. Lynn Glenney, Mr. Tony Columbo and Mr. Bert Hale, all of the Planning Research Corporation, who provided much advice and a considerable amount of their time; to Professor J. A. Tiedeman, for his many helpful comments; and to the Advanced Research Projects Agency (ARPA) which made it possible to spend a summer in the Republic of Viet Nam where I was able to observe some actual route security operations.

The following quote is included as a reminder that this type of study has value only if it can help those in the field gain some more insight to the problem of providing route security.

> "If ever there was a world in which situations do not repeat themselves like some mass production model, it is the military world. If we are to avoid the imposition of arbitrary limits to the exercise of judgment and control, let us be careful not to create in a mathematical vacuum situations which are based neither on past experience of affairs, nor on any conception of the innumerable variables and factors that determine social decision either today or tomorrow. The human brain, human values, human judgments, are still superior to the mechanics and processes of electronic computers or guidance systems. The day this ceases to be true there will probably be no human brains. But until then, let us use true scientific method as an aid to human judgment, and not as a hindrance. Science is human experience; it is not an alternative to judgments, and it is certainly not something that can operate outside human experience." [14]

CHAPTER I

INTRODUCTION

The ability to move freely in a hostile environment has been a goal of soldiers since the first military units took to the field many years ago. Attempts to achieve this ability for unhampered movement have traditionally tied down a large portion of any field army. Route security is even more difficult in the counterinsurgency environment due to the wide separation of units and the lack of well defined combat areas. The insurgent may attack friendly lines of communication (LOC's) to gain a psychological victory, to train his forces, to capture supplies, to slow the movement of friendly supplies and troop units or to destroy the moving elements.

The Greco-Persian War, which occurred almost five hundred years before Christ, provides an example of where the failure to provide proper security forces led to the loss of the campaign by the Persians.[9] In more recent times route security problems have had serious consequences for military units in the field. The French were unable to move in large portions of Viet Nam during their Indochina War and the Free World forces presently face a similar problem in the same area.

It would seem that a problem as persistent as route security could be viewed as a phenomenon which has certain existing variables regardless of the time frame and that these variables can be identified.

The purpose of this thesis is to identify and relate, in both a qualitative and quantitative way, those variables which have always been a part of the route security problem. At first glance three areas of interest appear. These are: (1) the environment, (2) the moving elements and (3) the security forces. See Figure 1 for a graphic portrayal of these three general areas. Each of these will be discussed in a separate chapter and it will be shown that when decisions are made affecting route security operations all of these three areas should be considered together.

Chapters II and III contain the discussion of the environment and the moving elements respectively. Chapter IV is a discussion of the security forces and their possible modes of employment. A synthesis is made in Chapter V and the various forces are examined in the light of the environmental and moving element factors. Chapter VI is an analysis of escort and reaction forces based on Lanchester's equations. Chapter VII contains the conclusions and recommendations.

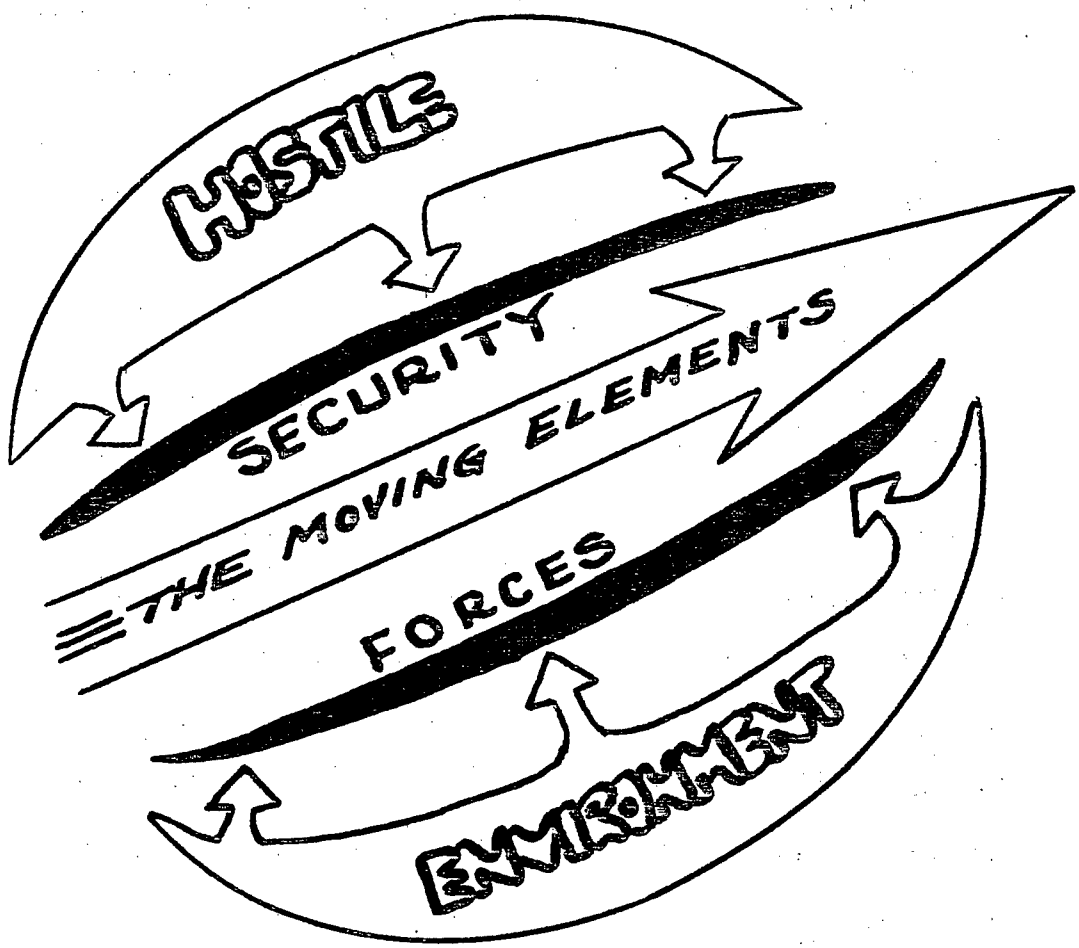

FIGURE 1

AREAS OF INTEREST IN THE STUDY
OF ROUTE SECURITY

CHAPTER II

THE ENVIRONMENT

Environmental factors which are related to the composition, employment and effectiveness of route security forces are the weather, the routes themselves and the threat posed by the insurgent. Each of these items plays a role in the environmental scene and although there is likely to be interaction among them they can be discussed separately.

A. WEATHER

Periods of reduced visibility such as rain, fog and snow can restrict the methods of movement available to the security forces as well as hampering the supporting air, artillery and naval gun fire. Normal expectations would predict a decreased efficiency in detection and intrusion devices in inclement weather. Therefore, any security force structure should be made responsive to climatic fluctuations. Variations in the weather will also alter the movement speeds of supply elements which may change their vulnerability to enemy action.

B. THE ROUTES

The routes over which the counterinsurgent may move are in the air, on roads or railroads and on rivers. Conceptually the security problem in all these cases is the same but the primary emphasis in this paper will be placed on movement by road rather than air, rail or river. Clausewitz in his book ON WAR, said of roads,

> "The value of these roads depends on their length, their number, their situation, that is their general direction and their direction close to

> the army, their quality as roads, difficulties of ground, the political relations and feelings of the local population, and lastly, on the protection they derive from fortresses or natural obstacles of the country." [1]

In areas where counterinsurgent operations may take place in the future it is unlikely that sophisticated transportation networks will exist. This fact limits the alternate routes that may be available in the event of enemy interdiction. The routes should be studied carefully to ascertain the political and economic implications of their use. In some areas the local economy will require considerable civilian traffic on roads which in many cases helps to reduce the frequency of insurgent initiated incidents. It is difficult to mine a heavily traveled road and the alienation of the local populace may not be a profitable move for the insurgent. Since villagers who live abreast a particular route can be of great benefit in reducing the hazard to friendly movements this aspect must be studied closely. It may be less costly to route supply movements through the more friendly areas even though some extra mileage is involved.

Some excellent work has been done by the RAND Corporation on interdiction models and although primarily designed for the planning of air interdiction against the enemy they are applicable here. [6] [10] [19]. The number of likely ambush points and bridges could be plotted and used as a restraint to movement in a network analysis. Using longer routes with

---

[1] Clausewitz, Karl Von, On War, (Washington, D.C.: Combat Forces Press, 1953), p. 304.

lower attack probabilities could, in many instances, reduce the security forces required for protection. For instance, in the simplified network shown in Figure 2 there are two alternative routes which could be used. Route 1-2-6 is a three hour trip but has two likely ambush points and two bridges which are vulnerable to enemy action. If the bridges were blown a considerable engineering effort would be required for passage and the prospect of ambush would be provided for. Route 1-3-4-5-6 is a four hour trip but there is only one bridge on the route and no areas considered to be likely ambush points. The security forces required to protect a moving element on route 1-3-4-5-6 would most likely be less than those on route 1-2-6. If the additional hour of travel time is not a critical factor then it is clear that route 1-3-4-5-6 would be a better choice from the standpoint of security force requirements.

Engineer and intelligence units often analyze road networks in order to determine traffic capacities, maintenance requirements and tonnage limits for bridges. It may be advantageous to evaluate roads from a security standpoint in order to determine the expected security forces that might be required.

The routes to be secured will probably traverse many types of terrain and this has its security implications also. When helicopters are used to transport reaction forces the availability of landing zones is important. In the desert there will be few ambush sites along the route and helicopter landing zones will be virtually unlimited. If rapid

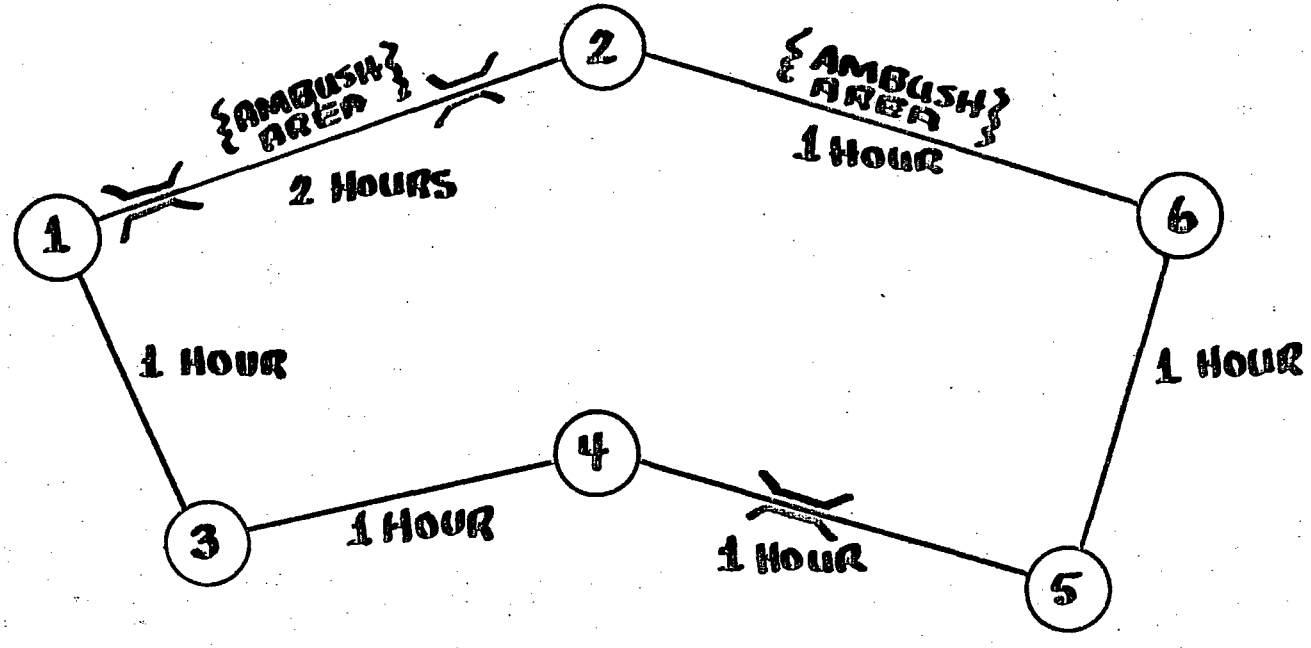

FIGURE 2

SAMPLE ROAD NETWORK WITH TWO ALTERNATE ROUTES

reaction forces can be provided an insurgent would require a method of high speed transport to insure his escape due to the good visibility afforded counterinsurgent aircraft. It is unlikely that large insurgent forces could be moved any appreciable distance, without being observed, in a desert environment. In jungle areas it can be expected that few clear helicopter landing sites will be available which could limit the effectiveness of air mobile reaction forces. Close cover for ambush sites will be abundant and the insurgent can be expected to be able to move large numbers of men without being detected.

Some routes will gain a certain degree of protection from their location and from man-made features in the immediate vicinity. A moving element traveling on a road which is flanked by a river is provided some protection on one shoulder due to the difficulty the insurgent faces in mounting an attack from the river side of the road. Defoliation of roadside vegetation provides an excellent field of fire for escorting security forces and makes it difficult for the insurgent to achieve the accurate close range fire required for an effective ambush. It may also be possible to use artillery to a greater advantage in defoliated areas due to the separation between the moving element and the attacker. Roads which are used for civilian commerce may not be profitable targets for the insurgent because of the possible loss of goodwill within the population dependent on the use of the road. Insurgents have depended on road traffic taxes for income in the past and this may deter them from destroying

or rendering impassable routes used for civilian travel. The armed forces can often shift to a method of air or sea resupply if a route cannot be used, thus the only effect of destroying the route turns out to be a loss of income for the insurgent.

C. THE ENEMY

The primary hazard to friendly movement in an area is the enemy's capability to interdict the lines of communication. It is desirable to have a classification system for the various roads so that a security force can be provided which is capable of countering the expected enemy force. Both enemy capabilities and intentions should be considered in such a classification system in order to account for the areas where the insurgent has large units but for some reason has decided not to employ them.

In the insurgency environment it can be safely assumed that the insurgent has the capability and to some degree the intention to interdict movement with isolated mines, grenades or snipers at almost any time. The knowledge that attacks on moving elements may cause the counterinsurgent to deploy large forces in a given area might deter the enemy even though he has a large force in the vicinity. If he is regrouping or training it is unlikely that he would invite retaliation by counterinsurgent forces. Insurgent objectives will certainly vary from time to time and may include attacking a convoy to slow down movement of friendly supplies, to kill troops, to resupply his own forces, train his soldiers or merely to harass counterinsurgent units and gain

some psychological advantage.

A classification system has been chosen which is based primarily on the degree of insurgent control in a given area. A method of color coding similar to the one used by the Marine Corps has been used to characterize areas with different levels of insurgent threat.[2] This system is easy to implement and provides a good verbal and graphic indication of the relative hazard to movement along a given route. (See Figures 3 and 4) Value judgments, visceral impulse, military judgment on quantitative values such as incident rate can be used in the hazard classification of a road network. Green, yellow and red are the colors used and the following is a general description of the expected environment corresponding to the various colors.

D. GREEN ROADS

The enemy maintains his capability to cause isolated incidents which probably involve only one or two vehicles on green roads. These areas are controlled by the counter-insurgent and will include such sites as major cities, logistic support areas and major headquarters areas. Travel by friendly personnel is generally unrestricted. The types of incidents to be expected are snipers, grenades and occasional mines.

E. YELLOW ROADS

Yellow roads are those roads over which the counter-insurgent has a predominance of control but where small

[2]U.S. Marine Corps, FMFM 8-2, Operations Against Guerilla Forces, (HQMC, Washington, D.C.: August 1962), p. 117.

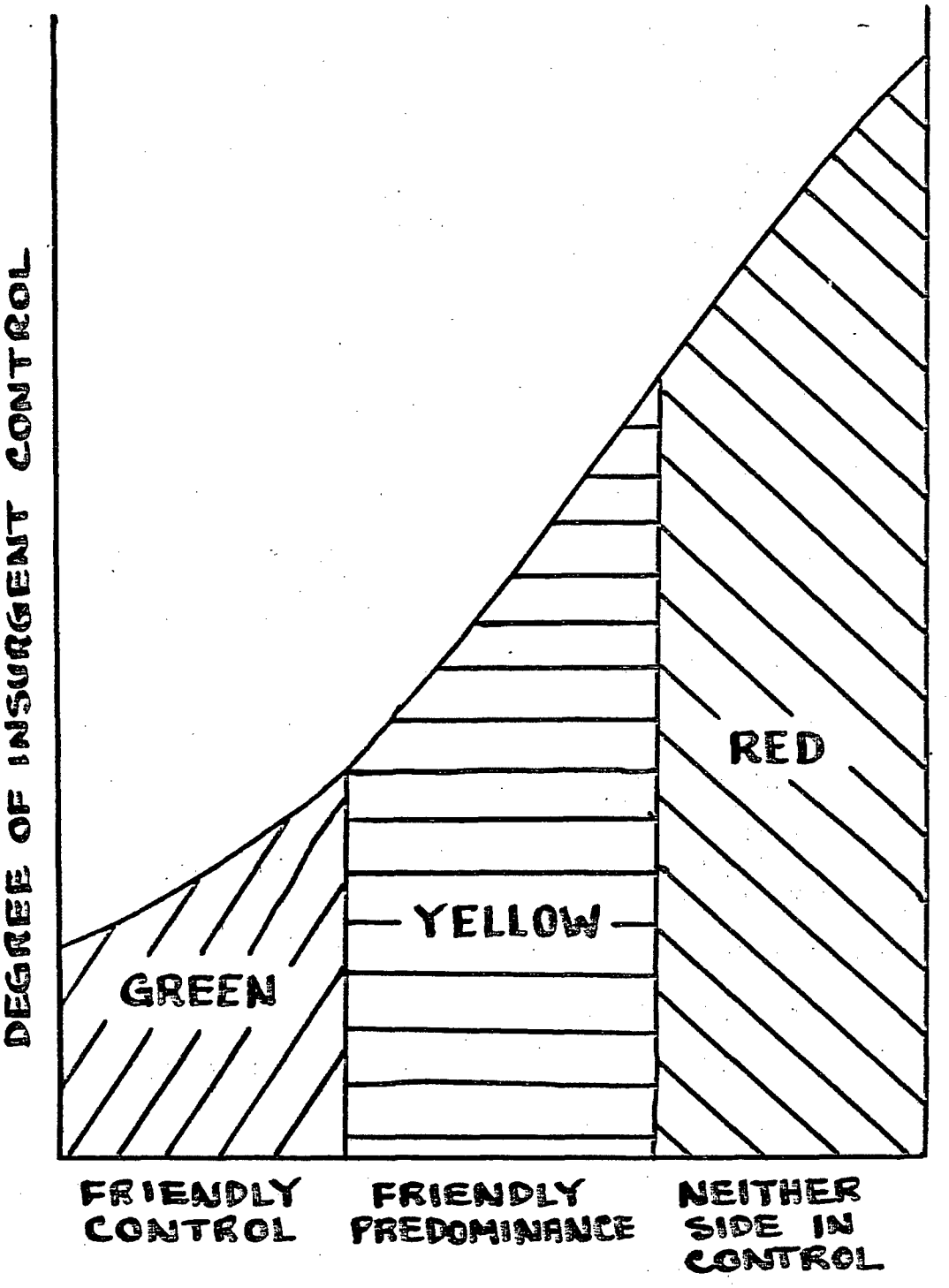

FIGURE 3

ROAD CLASSIFICATION USING DEGREE
OF INSURGENT CONTROL AS A CRITERIA

insurgent units may attack at almost any time. Rarely will the insurgent have the strength to stay and fight. These areas will include roads between nearby friendly installations, outskirts of major cities, and some main supply routes. Single vehicles will in all probability be prohibited from traveling on yellow roads.

F. RED ROADS

Red roads are considered to be in the combat area and here the insurgent has the capability of attacking in strengths up to and including a battalion. Military doctrine will normally require convoys for all military traffic on red roads.[17] The enemy may ambush convoys for a variety of reasons and will have the capability of staying to fight and overrunning unprotected moving elements.

The classification system must be flexible and responsive to change in the tactical situation or degree of pacification that may exist along certain routes. It is not necessary that a particular route be entirely one color or that it remain so for long periods of time. For example, the operations of friendly or insurgent tactical units may change the classifications as shown in Figure 4.

The friendly battalions which are operating on the route sectors A-B, C-D, and F-G may have the strength to effectively reduce those areas from red to yellow. While they are in the area it may be possible to reduce the security forces allotted to those sectors. Conversely, an insurgent operation along the route A-E might change its status from green to yellow or red depending on the level

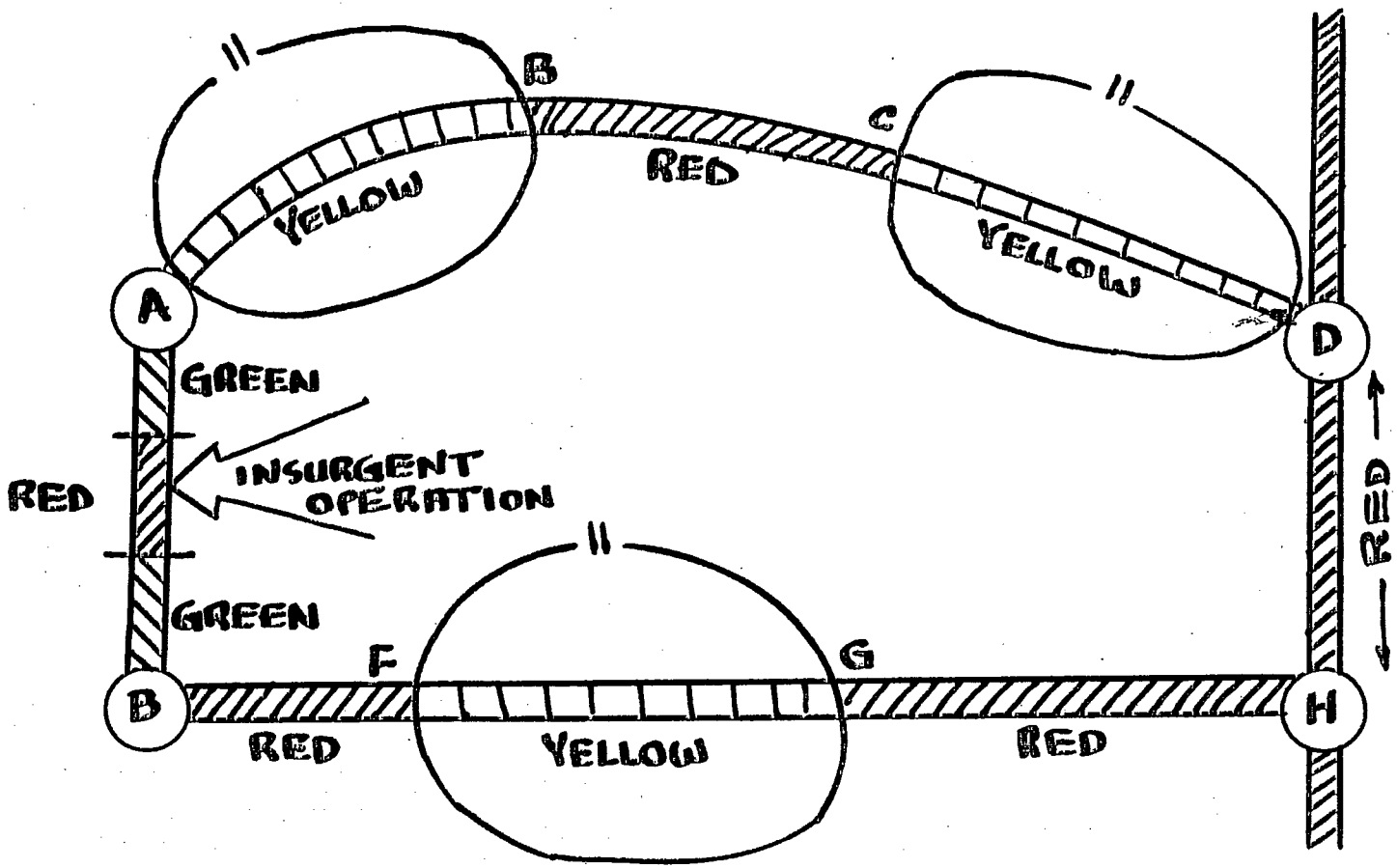

FIGURE 4

CHANGE OF ROAD CLASSIFICATION DUE FRIENDLY OR ENEMY ACTION

of hazard presented. A responsive route security system should be able to adjust to this type of change in order to effectively allocate the available security resources.

Thus far it has been shown that the weather, the routes and the enemy can affect a route security operation. A system of route classification has been chosen but it is now necessary to examine the moving elements to determine their effect on route security.

CHAPTER III

THE MOVING ELEMENTS

The primary reason for providing security for ground lines of communications is that the counterinsurgent would like to move at will along these lines. The reasons for movement in a counterinsurgency environment are many and the urgency requirements for each type of movement may vary considerably. The types of movement may be classified as civil, tactical or logistic; each of which will be discussed separately. A moving element will be considered to be any unit that is proceeding along a road be it a single truck or a convoy.

A. CIVIL MOVEMENTS

Civilian traffic, both intervillage and intracity will probably be greater than might be expected in a conventional war. The government should be able to provide security for civilian travel in order to convince the populace that the insurgent does not control the area. If the farm to market roads cannot be protected then the people will be forced to trade with the insurgent. Road taxes have been levied by the insurgent in Viet Nam and may be seen again in the future. Since road taxes may be a source of income for the insurgent it can be supposed that he will not try to cut the flow of traffic entirely but may continually harass movement in order to show his control. Most civil traffic will be found on green and yellow roads and normally the effect of reasonable delays will not be of major consequence. Because of the effect on the people, consideration should be

given to the political and economic implications of making certain routes secure enough for civil traffic to move at will and without having to pay a road tax.

B. TACTICAL MOVEMENTS

Military units involved in a tactical move will probably traverse green, yellow and red roads. It is assumed that these units will provide their own security with forces available within their organization. Typical of this type of movement will be heavily armed convoys and an effective system of command and control that can call upon assistance rapidly from a higher headquarters in the tactical chain of command. Delays in this type of movement may have serious consequences and therefore the necessary resources to insure a successful and timely move are usually made available.

C. LOGISTIC MOVEMENTS

It is the logistic moves which are most important to route security planners since these are usually made by major supply commands that do not have security resources directly available to them. Items moved may vary from critically needed ammunition to commodities for the PX. It has been stated, as a principle of moving military supplies, that in peace time the criteria is the least expensive transport mode and that in combat the major consideration is the timely delivery of required commodities.[3] But, what is "timely"? How much does it cost in terms of the available

[3]Research Analysis Corporation; Computer Simulation of a Theater Transportation System: A Feasibility Study, RAC-TP-146, (McLean, Virginia: RAC, June 1965), p. 23

resources to make this "timely" delivery? It appears that conceptually the idea of the least expensive mode of transport has importance even in combat. For example, assume that the number of vehicles required varies inversely with the time available to complete the movement and represent this relationship by a curve as shown in Figure 5. A sample set of data which is shown in Table I. was used in this example.

TABLE I

Number of trucks and time required for movement of 140 tons using trucks with a two ton capacity

DAYS AVAILABLE FOR MOVEMENT	NO. VEHICLES REQUIRED
1	70
2	35
3	24
4	18
5	14
6	12
7	10

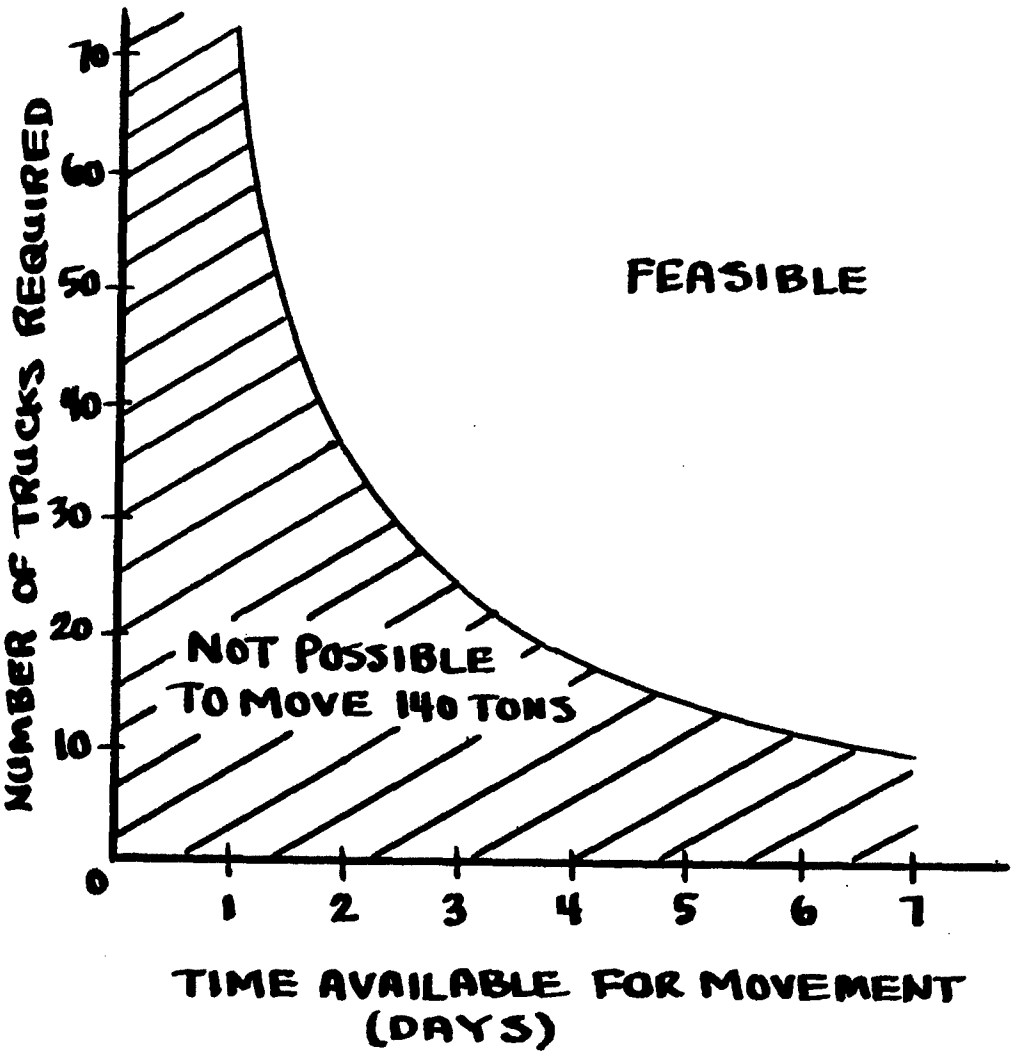

FIGURE 5

NUMBER OF TRUCKS VS. TIME REQUIRED
FOR MOVEMENT OF 140 TONS USING
TRUCKS WITH A TWO TON CAPACITY

Several things are implied in Figure 5. First, that the trucks move at the same speed and travel over the same route. Secondly, a round trip to and from the point of delivery takes one day so that a five day movement requires one-fifth as many trucks on any given day as is required for a one day movement. It can be seen that any point in the unshaded region is a feasible combination but only those points which lie on the curve are efficient. By this, it is meant that 140 tons could be moved in the unshaded region but some trucks would be empty or only partially loaded whereas the combinations on the curve all use the full truck capacity.

The security implications of the different combinations must also be considered. Depending upon the type and number of security forces available it may be more efficient to provide protection for the seventy-truck movement on a single day than it would be to provide protection to seven successive ten-truck movements.

If a constant size convoy is used but the percent of vehicles used to carry security forces is varied it can be seen that the flow of goods in a given period of time will decrease as the percentage of vehicles used for security forces is increased. For instance, a twenty-five vehicle convoy made up of three-ton capacity trucks could carry seventy-five tons if none were used for security forces. If ten trucks were used to transport security forces the payload would be reduced to forty-five tons. An increase in the percentage of vehicles employed for security forces

would also increase the probability of defeating an ambush due to the increased strength available. This may occur as shown in Figure 6.

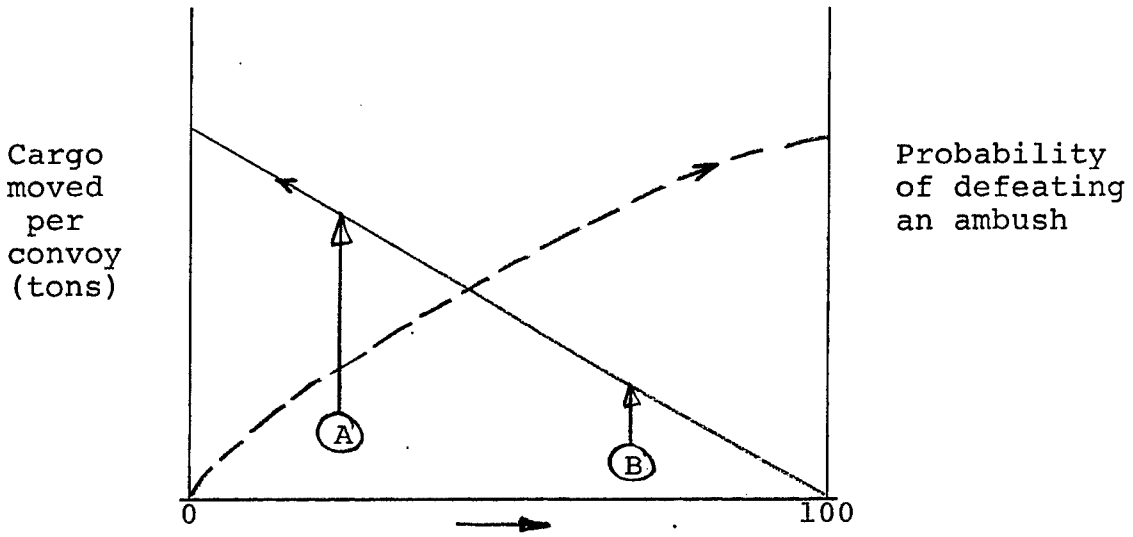

FIGURE 6[4]

Tradeoff Between Cargo Moved and Security for Security Forces of Sizes

If the primary objective is to maintain a high tons-moved figure and a lower, but acceptable, ability to defeat an ambush with escort forces then perhaps point A may be chosen in Figure 6. The concept here is that if one can afford the lesser probability of defeating an ambush then more tons of cargo can be transported by a fixed size convoy. Operations in the left hand portion of Figure 6 would probably be acceptable on all green and some yellow roads.

[4]Deitchman, Seymour J., "Applications of Operations Research to Internal War", Army OR Symposium, Proceedings, (Army Missile Command, Redstone Arsenal, Alabala: March, 1965), p. 215.

If the requirement to defeat the ambush is the overriding consideration then points in the vicinity of B may be chosen. Operations using the mix indicated by point B are probable on red roads. An example might be a show of force operation where the tons of goods moved is of secondary importance.

A similar diagram can be drawn for the size of the convoy. As convoy size is increased the probability of defeating an ambush is increased due to the larger number of troops available to counteract any enemy action. This implies a fixed percentage of vehicles used for security forces. It is not intuitively obvious why the tons-moved in a given period of time is less with larger convoys but an example may clarify this point. If some given number of trucks are to be routed to a particular destination, and a fixed loading time exists for each vehicle and a limited number of loading crews are assigned then there will be less slack time in dispatching vehicles in a smaller convoy. For instance, given 100 trucks, a 10 minute load time and 10 loading crews; ten-truck convoys could be dispatched every 10 minutes. A one hundred truck convoy could not be dispatched for 100 minutes. Combined with the fact that larger convoys require more control personnel and generally travel at slower speeds than smaller convoys it seems clear that the tons moved in a given period of time decreases with an increase in convoy size. If the curves are similar to those shown in Figure 7, then point A might be chosen when the goal is to maintain a continuous flow of goods with a high buildup rate while accepting a relatively low

ability to defeat an ambush with escorting forces. Points in the vicinity of B, which imply large convoys, may be chosen when the requirement to defeat the attacker takes on increased importance. The actual shape of the curves

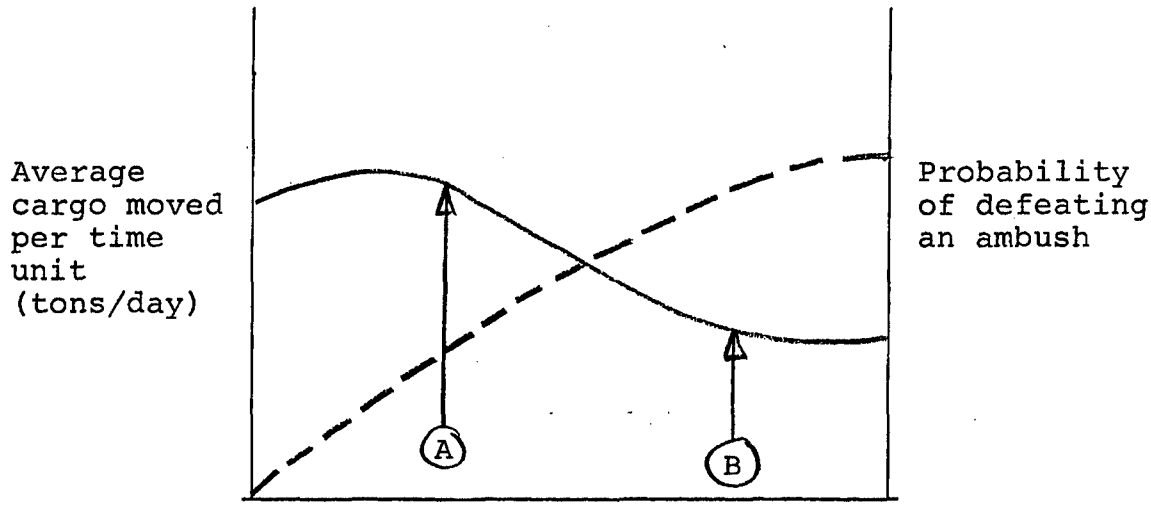

FIGURE 7[5]

Tradeoff Between Cargo Moved and Security for Convoys of Various Sizes

shown in Figures 6 and 7 will have to be determined empirically and troop tests could provide the necessary data for planning purposes.

The moving elements have been examined and now the structure and modes of employment of the security forces must be studied.

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[5]Ibid.

CHAPTER IV

THE SECURITY FORCES

Of primary interest in this chapter is the force structure available to provide security to the route and its possible methods of employment. In Chapter V the relative merits of the alternative force/employment modes that are generated will be analyzed in the light of different environments and moving element considerations.

The first element of the security forces which are available are the normal military units, both allied and indigenous. Of interest are the following types of units.

- o INFANTRY
- o ARTILLERY
- o ARMOR
- o AIR
- o ENGINEER
- o INTELLIGENCE

These units can seek out and destroy insurgent elements, provide increased mobility to the moving elements[6], surveillance of the routes, close air support and logistic support to other counterinsurgency units. Military units are normally armed with a large variety of weapons and are capable of moving over almost any type of terrain. They have effective command and control procedures and are usually well trained.

[6]The engineers can repair roads and bridges or build bypasses and the protection given by the combat arms may allow the moving elements to move faster than would otherwise be possible.

Also available are the police forces of the country involved in a counterinsurgency effort. The police can be used to direct traffic, set up check points and aid in the intelligence collection effort. They may also be used to patrol routes and outpost areas, such as bridges, requiring additional security. Military police units can also be used for the above tasks.

The paramilitary forces available will depend to a large degree upon the amount of preparation that has been made by the counterinsurgents. These units may include a variety of preparation states; from unpaid, non-uniformed local inhabitants to uniformed paid volunteers who are well armed and trained. They can be utilized to provide security for installations in their local area but they have a limited offensive capability. Paramilitary forces may also be used to maintain surveillance, protect the local populace and support the counterinsurgent effort in their own villages.

The modes of employment for these forces in route security could be as follows:

A. ESCORT

B. REACTION

C. STATIC

D. PATROL

There are possibly more ways in which to employ these forces but in concept these four modes cover the readily conceivable route security missions. (see Figure 8)

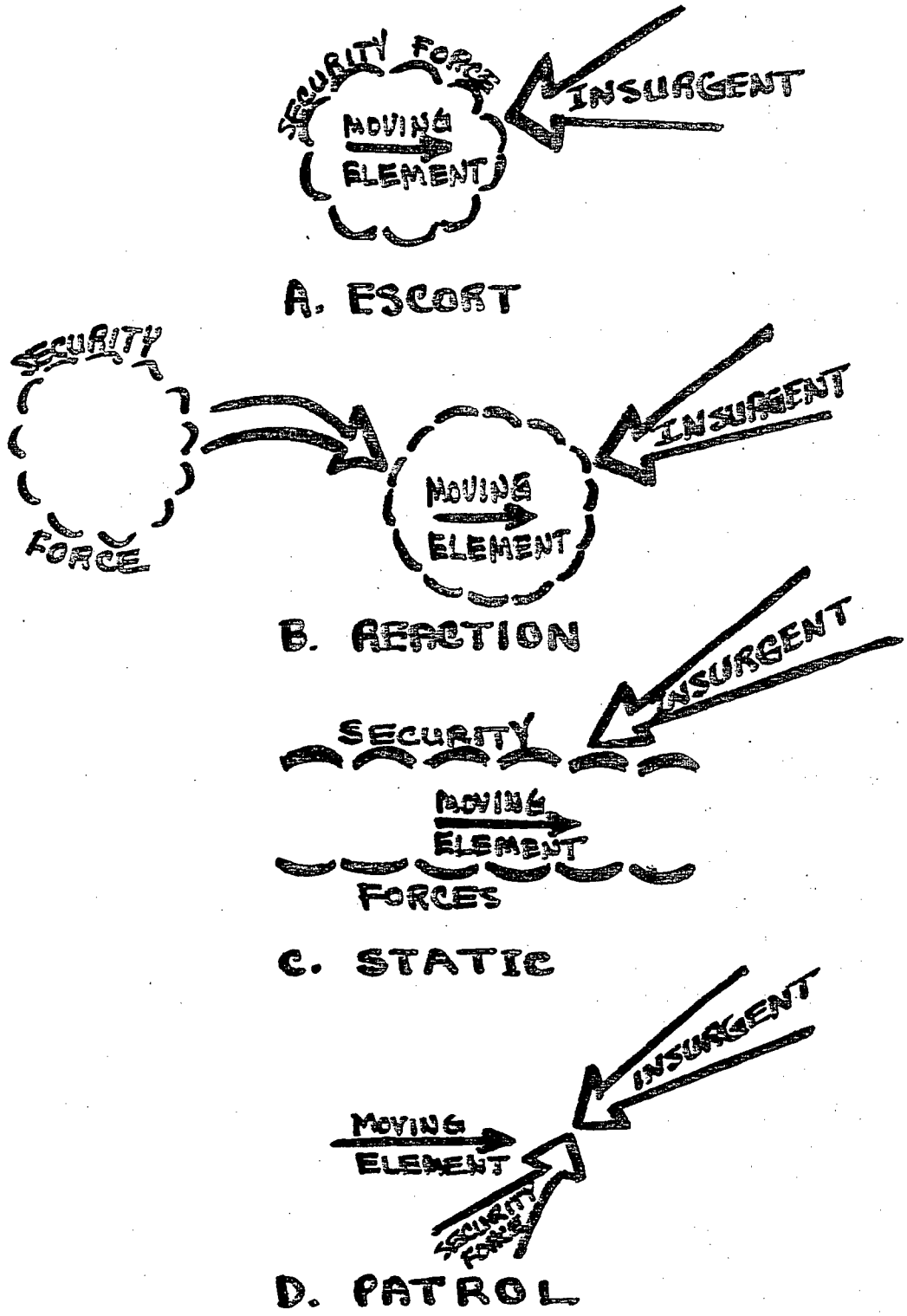

FIGURE 8

FOUR POSSIBLE MODES OF EMPLOYMENT

A. ESCORT MODE OF EMPLOYMENT

Units employed in the escort mode will be considered to be actually traveling with the moving elements. Ground and aviation units can be employed in the escort mode. This method of employment offers an immediate reaction to enemy attack but requires large numbers of troops to provide an escort for every moving element.

The drivers of individual vehicles, if armed, can be considered to be a light escort. Armed assistant drivers can also be used to advantage in some areas.

Consideration should be given to the location within a convoy of units employed in an escort mode. The units should be dispersed throughout the convoy in order to provide protection for the entire convoy. Armored vehicles can be employed in the escort mode and provide the convoy commander with a ready source of firepower in the event the convoy is attacked.

Automatic weapons and weapons with large single shot areas of effectiveness will probably be best suited for use by troops employed in the escort mode. The one big disadvantage of this type of protection is that a large amount of resources are tied down and if the probability of attack is low in a given area this may be an expensive luxury.

B. REACTION MODE OF EMPLOYMENT

Employment in the reaction mode implies that the security force is not physically present but can arrive at the scene of conflict promptly. The reaction time is a function of distance, speed of travel, readiness and

availability. The size of the reaction force may be a function of enemy strength. Referring to Figure 9 it can be seen that a moving element which has been stopped at point C could be supported by reaction forces departing from either A or B.

A method which could be used to estimate the expected time required for reaction by various forces is the following:

$$T = C + ED + \frac{M}{S} .60 + DE \qquad (IV.I)$$

Where:

T = Reaction time (minutes). Reaction time shall be considered to be that time which elapses between the realization that a reaction force is required and the time that the reaction force is deployed against the enemy.

C = Communications delays (minutes). Includes such things as indigenous government approval of airstrikes, etc.

ED = Embarkation-deployment time (minutes). This would be an average time, based on experience, for the forces to load, unload and engage the enemy.

M = Distance to the ambush site (miles).

S = Speed of movement for the reaction forces (mph). For example, 30 mph for truckborne forces and 60 mph for heliborne forces.

DE = Delays enroute due to enemy action (minutes). This is a random variable and planners could use an expected value. Helicopters may be delayed due to hostile fire or insecure landing zones in the objective area. Motorized relief forces may have to fight several engagements enroute.

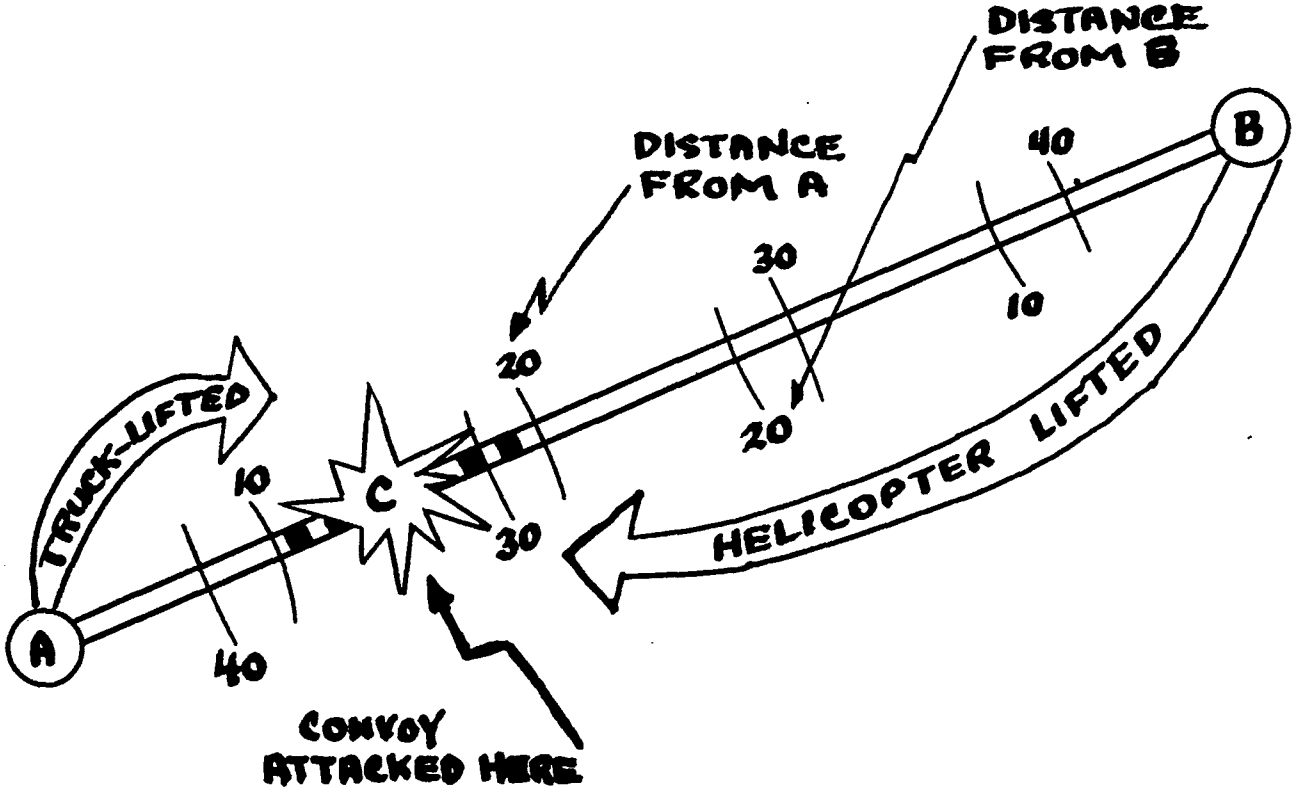

FIGURE 9

DISTANCE ARCS FOR REACTION FORCES MOVING FROM TWO DIFFERENT LOCATIONS TO SUPPORT A CONVOY WHICH HAS BEEN ATTACKED

For instance, equation IV.1 might be used in the following way. Given the forces shown in table II a decision must be made as to which force to commit to provide relief for a convoy stopped at point C in Figure 9.

TABLE II

Data for example of reaction time computation

Type Force	Location	Speed	Comm Delay	Embark Deploy time	Enroute Delays	Distance To C	Distance From A to B
HELIBORNE	B	60	10	30	10	34	48
TRUCKBORNE	A	30	10	15	20	14	

For the heliborne force we have:

$$T = 10 + 30 + \frac{34}{60} .60 + 10 = 84 \qquad \text{(IV.2)}$$

For the truckborne force we have

$$T = 10 + 15 + \frac{14}{30} .60 + 20 = 73 \qquad \text{(IV.3)}$$

The times and speeds shown in Table II may not be realistic but in concept the decision could be made using this method. In the simple example given previously the truckborne force was indicated as providing a faster reaction time. If everything else remained constant except the point at which the moving element was attacked then it is possible to determine at what distance from A it would be more expedient to commit the heliborne force.

Let X = Distance from A in miles

Now, to find the point at which the reaction times are equal we solve the following equation:

$$10 + 15 + \frac{X.60}{30} + 20 = 10 + 30 + \frac{(48-X)60}{60} + 10 \qquad \text{(IV.4)}$$

T (truckborne) = T (heliborne

which gives X = 17.66 miles.

Hence, one could say that when the convoy is more than eighteen miles from A the heliborne force provides a quicker reaction time. By studying the various road nets in this way prior to actual attack on convoys a commander responsible for route security could have available some predetermined decision rules with which to operate.

Reaction forces can aid an attacked unit in two ways. First they can, upon arrival, support the moving element by attacking the insurgent. Secondly, the knowledge on the part of the insurgent that reaction forces may arrive soon might cause him to break contact earlier than he would if he knew no reaction forces were available.

C. STATIC MODE OF EMPLOYMENT

Route security forces can also be employed in a static mode by deploying units along dangerous routs or building a line of fortified positions. Units which occupy fortified positions must have sufficient strength not only to carry out route security missions but also to prevent the position from being overrun by the insurgent. It has been found in the past that units of at least platoon strength are required so that the individual soldier feels secure enough himself to be effective.[7]

[7]Special Operations Research Office; A Study of Rear Area Security Measures, SORO/CINCFAC/0090/65, (Washington, D.C.: SORO, July 1965), p. 19.

If forces are not available to occupy all the fortified positions with the required strength then they can be manned on a random basis. If, for example, there were ten positions and personnel available to occupy only six of them, then a different set of six positions could be occupied each day.

D. PATROL MODE OF EMPLOYMENT

The patrol mode offers the counterinsurgent an offensive as well as a defensive tool for route security missions. Motorized patrols can move along the routes and may trigger some ambushes so that logistic convoys can move with reduced security forces. A patrol with a hidden offensive capability, in the form of a high speed reaction force, could be sent out in an attempt to invite attack. This is similar in concept to the World War II use by the Germans of Q ships. Helicopters could be used to transport patrolling ground forces and can cover large areas by choosing patrol routes on a random basis.

For example consider the situation depicted in Figure 10. The landing zones are numbered and each helicopter is assigned a sequence of three randomly chosen numbers which should eliminate any predictable pattern for the patrol effort. Each of the three different types of lines in Figure 10 represent the patrol path of a helicopterborne force. At each landing zone the troops disembark and proceed on a normal foot patrol. They then reload and proceed to the next assigned landing zone. This method would make it somewhat difficult for the insurgent to move in the area since at any time a heliborne patrol may be dropped somewhere

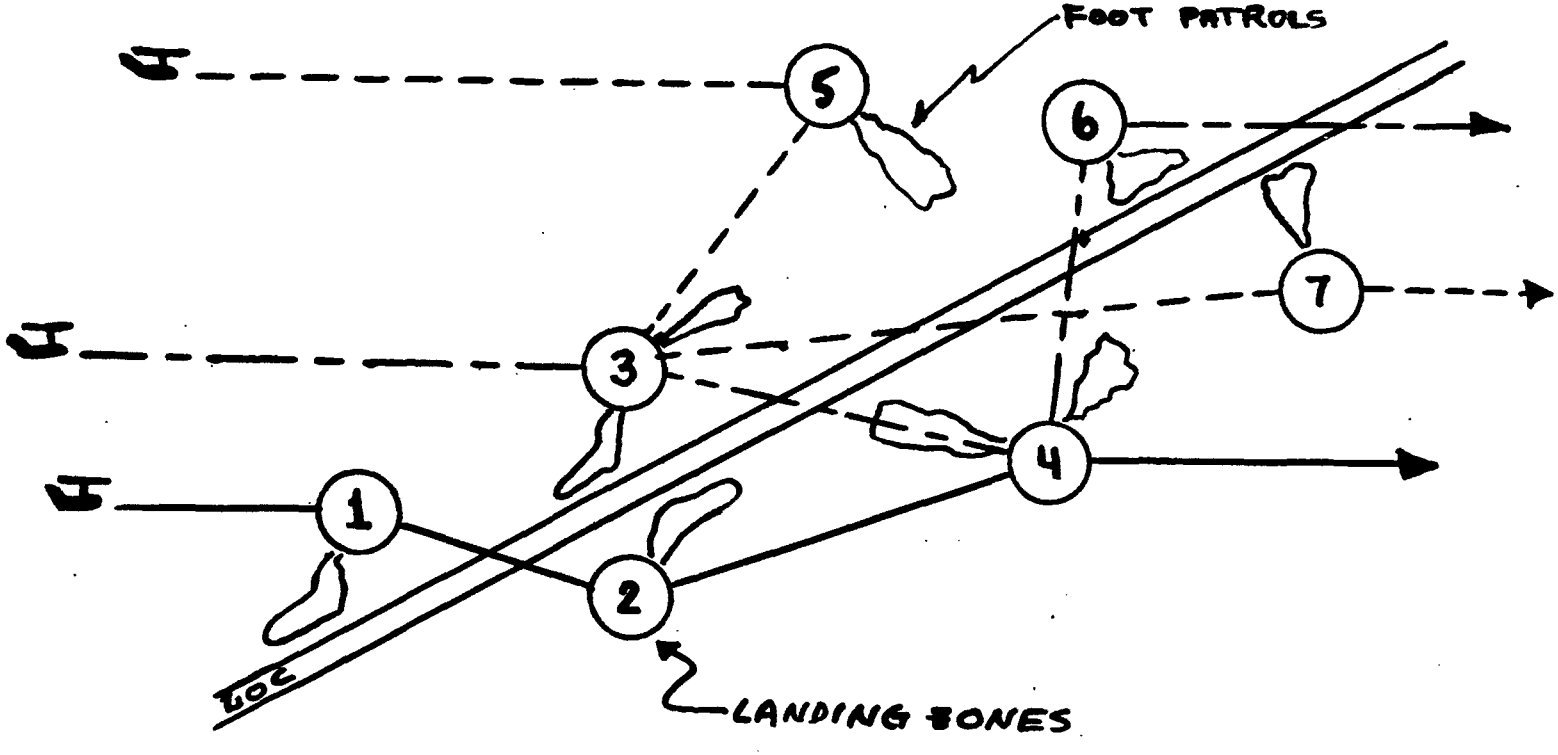

FIGURE 10

EXAMPLE OF PATROL ROUTES FOR HELILIFTED
PATROLS WITH RANDOMLY CHOSEN LANDING SITES

in the immediate vicinity. This same technique could probably be utilized by police squad cars or regular foot patrols.

E. FORCE/EMPLOYMENT MODE COMBINATIONS

The intelligence collection effort of the counter-insurgent force will probably include those items of interest to the route security forces and this will probably make the requirement for a separate intelligence capability unnecessary. Communications are vital and agencies controlling route security forces should receive all pertinent intelligence information as quickly as possible.

One tool which can provide on the spot intelligence of immense value to a moving element is the helicopter employed in the escort mode. Information concerning blown bridges, route obstructions and likely ambush sites can be relayed to the convoy commander immediately so that appropriate action may be taken.

Route security planners must make decisions on the employment of the engineer units with the primary question being whether or not to employ them in the escort mode. Engineer units help to maintain the momentum of the moving elements but are usually in great demand in the counter-insurgency environment due to their contribution to the civic action and nation building programs.

In areas where bypasses can be rapidly built to replace blown bridges, it may prove profitable to employ engineers in the escort mode so that moving elements will not be slowed and therefore more readily subject to attack. Where

the repair effort to the road requires a longer time period it may prove more profitable to have the engineers employed in a reaction mode. Some combat engineer units will probably be deployed with their parent commands in the static mode but this will be relatively rare. Engineer units are in general unsatisfactory for employment in the patrol mode because they are nonproductive for long periods of time.

POLICE/ESCORT: Police can be used in the escort mode but are usually lightly armed and incapable of fighting a determined attacker. Some special police units such as border patrol police may be better suited for employment in the escort mode because of their heavier weapons.

POLICE/STATIC: This is the most normal employment of police units and it is hoped that their presence will be a deterrent to small scale incidents by the insurgents.

POLICE/REACTION: Police units can provide a reaction force but again their weapons and training are not usually suited for fighting a determined attacker. Because of their reliance upon bicycles and motorcycles for transportation and the fact that many police must move on foot it can be seen from equation IV.1 that their reaction time will probably be extremely slow. Military police units can provide a considerably more effective reaction force than regular police units and may even have such vehicles as armored cars to use for rapid transit.

POLICE/PATROL: Patrols by police units, both foot and motorized, can be effective in making movement by the insurgent more difficult and could aid in the intelligence collection effort.

PARAMILITARY/ESCORT: Because of the local orientation of most paramilitary forces they can be used in the escort mode but should probably be used only over short distances. Their knowledge of the local area may prove invaluable in spotting ambush sites.

PARAMILITARY/STATIC: This will probably be the most likely employment of paramilitary forces and would include the guarding of bridges and other local installations.

PARAMILITARY/REACTION: A reaction force can be provided but unless external transportation can be provided the timeliness will be very poor due to the requirement to move by foot.

PARAMILITARY/PATROL: Extensive patrols can be conducted by paramilitary units and their knowledge of the local terrain may make it possible for them to ascertain when the insurgent has been operating in the area.

INFANTRY/ESCORT: Infantry units are effective in the escort mode but require transportation with similar speed characteristics of the moving elements. This increases the size of the convoy and if the moving element is not attacked the escorting troops and trucks are unproductive. There is however, a good possibility that some deterrent effect on the insurgent is provided by the presence of the infantry escort.

INFANTRY/STATIC: Infantry employed in the static mode requires large numbers of troops to be effective and unless positions are occupied in strength there is the danger of them being overrun singly by the insurgents.

INFANTRY/REACTION: Infantry is well suited to this mode and the means of transportation may be foot, motor transport or helicopter. This will of course change the reaction time considerably.

INFANTRY/PATROL: All types of patrols can be conducted effectively by infantry units and this provides an offensive use for infantry units in route security missions.

ARTILLERY/ESCORT, STATIC, PATROL: These combinations are generally not applicable.

ARTILLERY/REACTION: Artillery units are actually a form of reaction force with respect to the moving element no matter how it is employed. Its long range gives artillery a good standoff distance and reduces its vulnerability to enemy action. If artillery is helilifted to the ambush area as a part of a mobile reaction force its effect is the same as if it were firing on call from a more secure position.

ARMOR/ESCORT: Armor units which shall be considered to include tanks, armored cars and armored personnel carriers can be effectively used in the escort mode. Armor has the advantage of being able to move in the killing zone of an ambush and can attack the insurgent when the infantry is pinned down. The off-road travel capabilities of armor units may also be useful in some instances.

ARMOR/STATIC: Armor units could be employed in the static mode but this is usually a last resort if there are no alternative uses which can capitalize on their inherent capabilities.

ARMOR/REACTION: The reaction speed will probably be greater than that of motor transport and certainly less vulnerable to enemy action but slower than air mobile units.

ARMOR/PATROL: This may be the most effective employment of armor units due to their relative invulnerability to enemy action and the possibility of flushing out enemy ambushing forces. Routes can be patrolled by armor units and if contact is made they most likely will be able to stand off the attacker until reinforcements can arrive.

AIR/ESCORT: This combination provides a timely, powerful force to the moving element which can be used for intelligence, communications or immediate firepower. Air resources however, will usually be in great demand and it is unlikely that the priority assigned to the security of moving elements can compete with that assigned to bombing and close air support missions by fixed wing aircraft. Helicopters may be used in this mode for elements moving in particularly hazardous areas or with especially important cargoes.

AIR/STATIC, PATROL: This combination is generally not applicable.

AIR/REACTION: This is probably the most reasonable use of air resources in the counterinsurgency environment where there is a low likelihood of an enemy air threat. There are three probable ways in which air resources can provide a reaction force. Ground alert - in varying degrees of readiness pilots and planes are in a standby status on the ground. Reaction time will include alert time, travel time and communications delays. Airborne alert - Aircraft are airborne and can be sent almost immediately to the ambush site. Divert status - here the aircraft are flying other missions but can be diverted to the ambush site if needed. One of the problems that arises is ordnance loading. The possibility of arming aircraft with antipersonnel ordnance when there is a chance of their being diverted should be considered.

In order that the available resources can be used in the proper area the relative effectiveness of the units must be evaluated. Four criteria that can be used are firepower, vulnerability, responsiveness and availability. [12] (See Table III) It is implied that the units are commensurable. It must be determined for instance that one tank is equivalent to some number of infantry, artillery or aircraft.

TABLE III

Relative ranking matrix for force/mode of employment combinations

Ranking by mode	Mode	Ranking by force type: Infantry	Artillery	Armor	Air	Police	Paramilitary	Measure of Effectiveness
No Effect *	Escort	2	/	3	1	5	4	FIREPOWER
	Static	1	/	2	/	4	3	
	Reaction	3	2	4	1	6	5	
	Patrol	2	/	1	/	4	3	
4	Escort	3	/	2	1	5	4	INVULNERABILITY
3	Static	2	/	1	/	4	3	
1	Reaction	4	1	3	2	6	5	
2	Patrol	2	/	1	/	4	3	
1	Escort	1	/	5	4	3	2	RESPONSIVENESS
3	Static	2	/	1	/	4	3	
2	Reaction	4	1	3	2	6	5	
4	Patrol	2	/	1	/	4	3	
No Effect **	Escort	1	/	4	5	3	2	AVAILABILITY
	Static	1	/	4	/	3	2	
	Reaction	1	4	5	6	3	2	
	Patrol	1	/	4	/	3	2	

* A fixed size force has the same firepower regardless of the mode of employment. The type rankings change because some resource/mode combinations are not applicable.

** For example, if a platoon of infantry is available for route security duty it can be used in any mode.

Table III is only an example of how the units could be ranked. It is possible that in some countries the police will be more responsive than the military or that air will be more available than armor. The rankings shown here are somewhat arbitrary but in actual practice more precise rankings could be made based on operational experience. With this type of information a decision maker can evaluate alternatives. For example, although air provides great amounts of firepower in the escort mode, its responsiveness and availability are less than infantry. The real value in filling out such a table is that it provides a means whereby planners can consider in detail the performance of the resources available.

With the variety of useable resources and their possible modes of employment the tools available for the route security operation are many. However, consideration must also be given to the question of when to use each tool.

CHAPTER V

SYNTHESIS

In order that the security forces can be properly allocated the tasks which they may be required to perform must be defined. In the event the moving element is attacked or stopped for some reason, it should have the capability to accomplish all of the following tasks.

A. REPEL

B. COUNTERATTACK

C. PURSUE

D. PROCEED

E. PREVENT

These five tasks can be accomplished in a variety of ways and for clarity will be separately defined.

A. REPEL

The ability to repel an attack is the ability to withstand the initial fire of an attacker and to provide a sufficient amount of return fire to prevent being overrun for a given amount of time. Armored vehicles may be capable of withstanding intensive enemy small arms fire and without further action have the capability to repel for limited amounts of time. This time period is lengthened when their own firepower is brought to bear on the attacker. Escorting infantry troops give a moving element a capability to repel for a length of time determined in part by the relative strengths of the opposing forces. Anti-personnel devices mounted on the sides of vehicles give the moving element a means of repelling an attack for short

periods. Armed helicopters in the escort mode could also provide the moving element with the capability to repel an attack.

B. COUNTERATTACK

The ability to counterattack is the ability to take offensive action against an attacker so as to relieve the pressure brought to bear on the moving element. Infantry units in either the reaction or escort mode can accomplish this task. All reaction forces can provide a counterattack capability but the reaction time required will depend to a large degree upon the moving elements' capability to repel. For instance, a moving element with a large heavily armed escort could hold off the attacker and possibly mount a counterattack without calling upon a reaction force. Conversely, the reaction time required to effectively support a lightly escorted moving element is short and the size of the force would depend in part upon the strength of the attacker.[8]

C. PURSUE

The ability to pursue is the ability to continue the attack against the enemy until he is well clear of the moving element or until he can be destroyed. This will probably require larger forces than would conceivably be escorting a moving element. Almost all reaction forces can provide this capability to some degree. Pursuit is important if the route security forces are to prevent the

[8]See Chapter VI for a quantitative examination of this trade off.

attackers from returning time and time again. This is a tedious task in the counterinsurgency environment but is extremely important. Much time and effort is spent in counterinsurgency operations looking for the enemy. Once a convoy has been attacked the enemy has been located and should be destroyed if at all possible. The ability to pursue rapidly may contribute a great deal to route security in the long run.

D. PROCEED

The ability to proceed is the ability of the moving element to move its load to the prescribed destination in the allotted time. If the moving element is attacked and stopped the proceed task can be accomplished by recovery, replacement or rerouting. The building of a bypass when a bridge has been blown is an example of recovery while transferring goods from destroyed vehicles to previously empty ones is an example of replacement. Rerouting would be the use of an alternate route. Moving elements with high priority cargoes will probably require that increased attention be paid to the proceed task. It may be necessary to have engineer units accompany a moving element so that roadblocks, mines or other obstacles can be neutralized rapidly.

E. PREVENT

In addition to the previously defined capabilities the security forces should attempt to prevent attack if possible. Aggressive patrolling may discourage the insurgent from attacking moving elements due to the high risk of capture

or death that he takes when moving through areas that are well patrolled. If it is apparent to the insurgent that attacking a moving element will bring on a rapid and strong reaction by his opponent he may look for less costly objectives. This has its hazards also and may be an example of not seeing the big picture on the part of the route security forces. The problem at hand however, is how to provide security for the moving elements. Artillery fires which cover likely avenues of approach and forces deployed in the static mode on bridge defense missions are also examples of forces which may be used for the prevention task.

Figures 11, 13 and 14 show the resource/mode of employment combinations that are available for accomplishment of the various tasks. Also shown are preferred combinations for task accomplishment. Information on red, yellow and green areas is given in separate figures and each will be discussed separately.

F. DISCUSSION OF SECURITY FORCES IN RED AREAS

A heavy employment of close combat resources in the escort mode is indicated for the accomplishment of the repel and counterattack tasks. An additional benefit of a heavy infantry-armor escort force is the effect it may have on the attacker. Paramilitary forces will probably be used only in the static mode for guarding bridges and other vulnerable points in the road network. Military police units if available can be used to direct traffic in villages or help in the control of two way traffic. Artillery in the reaction mode provides the moving element with rapid

	RESOURCE	MODE	TASKS (A) REPEL	(B) COUNTER ATTACK	(C) PURSUE	(D) PROCEED	(E) PREVENT
CLOSE COMBAT	INFANTRY	E	A*	A*	A		A*
		R		A	A*		
		S					A
		P					A
	ARMOR	E	A*	A*	A		A*
		R		A	A		
		S					
		P					A
	PARA-MILITARY	E	A	A	A		A
		R		A	A		
		S					A*
		P					A
	POLICE & MP	E				A	
		R				A	
		S				A*	
		P					
	ARTILLERY	R		A	A*		A*
AIR	ARMED HELO	E	A	A*	A		A*
		R-GA		A*	A*		
		R-AA		A	A		
		R-D		A	A		
	FIXED WING	E	A	A	A		A
		R-GA		A	A*		
		R-AA		A	A		
		R-D		A	A		
	ENGINEERS	E				A*	
		R				A	
		S					
		P					

NOTE:
A = AVAILABLE
* = PREFERRED

FIGURE 11

RESOURCE MATRIX - RED AREAS

fire support on short notice. Artillery can also be used for the accomplishment of the prevent task by providing fires on likely approach routes and ambush points. Pre-planned defensive fires can be used for bridge defense and thereby make the route less vulnerable to interdiction by the insurgent.

A medium employment of infantry in the reaction mode is indicated for the accomplishment of the pursue task. Normally the high enemy threat will preclude the use of the escort forces for pursuit and reaction forces must be relied upon.

Armed helicopters can be used in the escort mode if available and provide a rapid firepower capability for the accomplishment of the counterattack task. For the pursue task the ground alert status can be used since the reaction time will probably be short due to the relatively short distances between destinations in the red areas. Fixed wing aircraft will probably not be used in the escort mode because of availability and the fact that their high speed provides an extremely short reaction time.

Because of the importance of keeping the convoys moving, the likelihood of poor roads and the high probability of enemy interdiction it appears that engineers should be employed in the escort mode. If employed in the reaction mode the time delay that may result could be disastrous to the moving element.

Weather can have serious effects in the red areas. Low ceilings may make it impossible to use aircraft and rain could make travel by motor transport extremely difficult.

The convoys in red areas will most likely be relatively large with a high concentration of available resources in the escort mode so that any likely attack can be repulsed and the convoy kept moving. There are several ways in which the escort forces can be positioned in the convoy but it would seem that a method such as shown in Figure 12 would have several advantages.

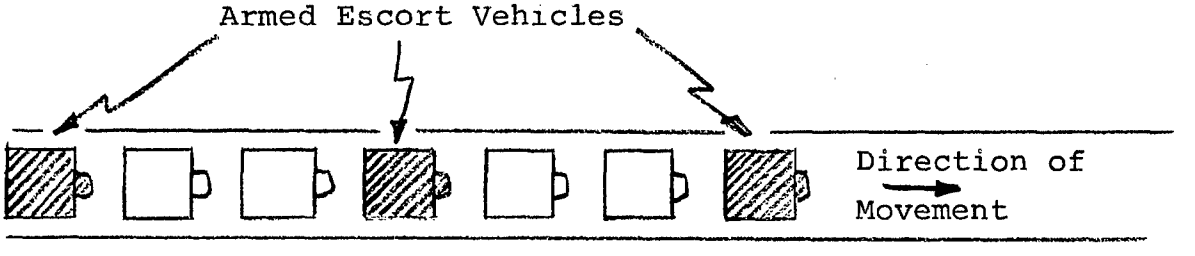

Figure 12[9]

Possible Position of Armed Vehicles in a Convoy

In areas where a high threat of ambush by large forces exists it is important that the security forces be spread out so that the cargo vehicles cannot be isolated and destroyed. If the security forces are spread out it is unlikely that large numbers of them will be in the killing zone at any given time and therefore are more readily available to mount a counterattack.

[9]Deitchman, loc.cit.

Generally, it appears that in the red areas an effective mode of employment for the security force would be a heavy force in the escort mode with a supplemental reaction force. This supplemental reaction force should be provided with a rapid means of transport such as helicopters if they are available.

G. DISCUSSION OF SECURITY FORCES IN YELLOW AREAS

A medium employment of available close combat resources is indicated for the accomplishment of the repel and counter-attack tasks due to a lower level enemy threat. Due to the probable higher frequency of movement in yellow areas and a reduced escorting force the reaction forces will have to be relatively large. Available artillery can be used in the same way as it is used in the red areas and preplanned concentrations will reduce the reaction time for effective artillery fires.

Military police units may be of some value as escorts in the yellow areas if they have heavy infantry weapons such as machine guns. Local police and paramilitary units can be used, for the accomplishment of the prevent task in either the static or the patrol mode. Some installations, such as bridges may require a static security force but units employed in the patrol mode can probably be equally effective in some areas and cover a much larger sector.

Armed helicopters may be used in the escort mode but probably only when intelligence reports indicate a higher than normal risk to movement. Detachments at various points in a ground alert status can provide a rapid reaction

	RESOURCE	MODE	TASKS (A) REPEL	(B) COUNTER ATTACK	(C) PURSUE	(D) PROCEED	(E) PREVENT
CLOSE COMBAT	INFANTRY	E	A*	A*	A		A*
		R		A	A*		
		S					A*
		P			A		A*
	ARMOR	E	A	A	A		A
		R		A	A*		
		S					
		P			A		A*
	PARA-MILITARY	E	A	A	A		A
		R		A	A		
		S					A*
		P					A*
	POLICE & MP	E	A*	A*	A	A	A
		R		A	A	A*	
		S				A*	A
		P				A	A*
	ARTILLERY	R		A	A*		A*
AIR	ARMED HELO	E	A	A*	A		A*
		R GA		A	A*		
		R AA		A	A		
		R D		A	A		
	FIXED WING	E	A	A	A		A
		R GA		A	A*		
		R AA		A	A		
		R D		A	A*		
	ENGINEERS	E				A	
		R				A*	
		S				A*	
		P					

NOTE:
A = AVAILABLE
* = PREFERRED

FIGURE 13

RESOURCE MATRIX - YELLOW AREAS

force for ambushed convoys and the total number of helicopters required would be less than the number required to escort all moving elements.

Fixed wing air forces may be employed in a divert status as well as in a ground alert status and consideration should be given to the feasibility of arming aircraft, that are subject to being diverted, for antipersonnel missions.

With a large number of convoys on the move it will probably not be feasible to provide engineers to escort all convoys. Therefore, they will most likely be employed in a reaction or static mode. There should be some engineers that are available and capable of being helilifted to trouble spots so as to reduce the delay time of moving elements. However, most of the engineer support will probably be moved by motor transport.

Generally, it appears that in the yellow areas the primary mode of employment for security forces will be the reaction mode with a sufficient escort force to repel and counterattack the expected size ambushing force. A relatively large reaction force is required to provide the necessary forces in the event of attack by enemy units larger than normally anticipated.

H. DISCUSSION OF SECURITY FORCES IN GREEN AREAS

In the green areas the primary threat is one of small incidents such as snipers, mines or grenades. Infantry and paramilitary forces will probably be used in the escort mode only for highly critical cargoes which require additional security precautions.

	RESOURCE	MODE	TASKS (A) REPEL	(B) COUNTER ATTACK	(C) PURSUE	(D) PROCEED	(E) PREVENT
CLOSE COMBAT	INFANTRY	E	A	A	A		A*
		R		A	A		
		S					A
		P			A		A
	ARMOR	E					
		R					
		S					
		P					
	PARA-MILITARY	E	A	A	A		A
		R		A	A		
		S					A*
		P			A		A
	POLICE & MP	E	A	A	A	A	A*
		R		A	A*	A	
		S				A*	A*
		P				A	A*
	ARTILLERY	R			A		A
AIR	ARMED HELO	E					
		R GA					
		R AA					
		R D					
	FIXED WING	E					
		R GA					
		R AA					
		R D					
	ENGINEERS	E				A	
		R				A	
		S				A*	
		P					

NOTE:
A = AVAILABLE
* = PREFERRED

FIGURE 14

RESOURCE MATRIX - GREEN AREAS

The primary security forces in green areas will probably be police forces, either civil or military. These can be employed in all modes but the escort mode will most likely be the least used. One of the main functions of police units will be to insure an orderly flow of traffic in green areas so that moving elements are not stopped for long periods of time. This is an invitation for attack and stoppages should be minimized.

Individual drivers should be armed and perhaps an armed assistant driver could be provided. This will normally be sufficient to repel the type attack anticipated in green areas. Some engineer capability must be provided for but considering the high likelihood of alternate routes the engineer tasks could presumably be handled in a routine nature by engineer units statically employed in the local area.

I. COMMAND AND CONTROL

Command and control in the counterinsurgency environment may be more difficult than in normal operations due to indigenous governmental control of such things as air strikes and artillery missions. The command and control aspects of a route security operation are extremely important and it seeme unlikely that a flexible and responsive security system can be built without an effective system of command and control.

Present policy dictates that control of the means of transportation should be exercised at the highest level

which can maintain effective control.[10] But, since security forces may be provided by completely separate commands an immediate coordination problem arises.

Tactical movements will probably be the easiest to control because the transportation units are usually organic to and subordinate to the tactical commander. In logistic moves by logistic commands with combat arms providing the security forces the command and control structure will probably be more cumbersome. Cooperation is appealing in concept but rarely provides the response and effectiveness that a task organized force under a single commander can elicit.

It appears that more effective command and control could be achieved on logistic moves by using a task organization similar to those used for tactical moves. A more effective system would probably result from giving the commander of the escorting combat forces the authority to control all the resources alloted to the task. The senior officer from the transportation command could then be designated as the assistant commander with the responsibility of controlling the technical aspects of the movement. Only on green roads where special security forces are not normally provided would the transportation officer have complete control of the moving element.

An effective command and control system would probably be one which is centrally commanded at the highest possible

[10] U.S. Marine Corps, TIP(LOG)4, Logistic Support of the Landing Force. (MCEC, Quantico, Virginia: 1960), p. 30.

level with the various movement elements task organized and equipped for decentralized direction once the resource allocations have been made.

It is desirable that communication networks be established so as to provide a rapid response by all reaction forces to include ground, air and engineer units. If intelligence is to have any value to route security forces some method of rapid dissemination should be devised. A system of intervehicular communications is required to insure a rapid response by escort forces to changing situations.

Whatever system of command and control is chosen its effectiveness will be enhanced if it is continually tested. By having practice alerts the involved personnel are provided an opportunity to test the system and to identify weak points. It may seem expensive in terms of time and effort to run practice alerts but the consequences of a failure in an actual situation may prove disastrous. A "five minute" alert force that is only a five minute alert force ten percent of the time cannot be relied upon to a very high degree. Good information on the true readiness and training levels of reaction forces could be the difference between success in route security and failure to accomplish the mission.

The effectiveness of the various route security forces is difficult to measure because of the difficulty in predicting the enemy intentions. In some areas unarmed convoys may pass without harassment because the enemy feels

it is more advantageous to allow this passage than to suffer the subsequent retaliation. In this instance security forces of any major size represent an overkill and although seemingly effective because the convoys are not attacked, a squad could possibly achieve the same results.

In general it appears that in the red areas escort forces will predominate supplemented by reaction forces. In the yellow areas a lesser use will be made of the escort mode and a greater reliance placed on reaction forces. In the green areas the security will probably be provided primarily by police type units employed for the most part in the static or patrol mode.

CHAPTER VI

A SIMPLIFIED EFFECTIVENESS MODEL FOR ESCORT AND REACTION FORCES

This chapter represents a first approximation for the problem of comparing the effectiveness of escort and reaction forces in performing route security missions. A form of Lanchester's equations is used to determine the length of engagement for an ambush by a fixed size insurgent force on an escorted convoy. A computer program was written which computes these engagement times for various size escorts, rates of fire and weapons effectiveness.[11] The program also computes the maximum distance from an ambush site that heliborne and truckborne forces can be positioned in order to provide support to an ambushed convoy.

Route security planners must make decisions on the size of the escort which will be provided for convoys moving in different areas. Available resources are assumed to include a limited number of infantry troops and some number of helicopters and trucks which can be used to transport reaction forces. The decision on whether to use helicopters or trucks will depend in part upon the distance from the ambush site and the required reaction time.

A. SCENARIO

In the scenario which is examined it is assumed that all personnel are armed with rifles and that no artillery or armor is available. The only aircraft available are

[11] See the Appendix for two versions of the program.

those helicopters which are used to transport reaction forces. A single convoy is proceeding along a route and is ambushed by a fixed size insurgent force. It is assumed that escort forces which accompany the convoy have limited cover available and that the attacking insurgents are hidden from view throughout the engagement. The friendly force can stay and fight or be reinforced by reaction forces. The insurgent can either stay and fight or break contact and flee.

B. THE LANCHESTER MODEL

S. J. Deitchman in his article "A Lanchester Model of Guerrilla Warfare" provided a variation of Lanchester's equations which can be applied to guerrilla warfare. [4] This model is a mixture of Lanchester's square and linear laws. The ambushing guerrilla fires on the convoy escort using point fire but the convoy escort is forced to use area fire because they cannot see the hidden attackers. Thus, the escort's loss rate will be proportional to the number of guerrillas which are firing whereas the guerrillas loss rate will be proportional to the number of escort troops firing and the number of guerrillas in the area into which the escort is firing. The equations which are used for this type of exchange are shown below. All notation used is the same as that used in the computer program.

$$\dot{G} = -A\ Fo\ Go \qquad (VI.1)$$

$$\dot{F} = -B\ Go. \qquad (VI.2)$$

Here G = Rate at which guerrillas are killed,

F = Rate at which the escort forces are killed,

Fo = Initial size of the friendly escort force,

Go = Initial size of the guerrilla force,

A = (RF) (AEF1)/AGT Attrition coefficient,

RD = Friendly rate of fire

AEF1 = Single shot area of effectiveness for friendly fire,

AGT = (AG1) (Go) = Total area the guerrilla force occupies. (AG1 is the area occupied by one guerrilla.)

B = (RG) (PG1) = Attrition coefficient,

RG = Guerrilla rate of fire,

And PG1 = Single shot kill probability for guerrilla fire.

The condition for equality is shown to be

$$Go = (A/2B)\ Fo^2. \qquad (VI.3)$$

C. THE COURSE OF THE BATTLE EQUATIONS

The following equations were shown by Deitchman and are included for the interested reader. For the case where $Go > (A/2B)\ Fo^2$ the guerrilla wins with $G_{final} = C_1$ and

$$G = C_1\left[1 + \left\{(Fo - K_1 \tan t\alpha_1)/(K_1 + Fo \tan t\alpha_1)\right\}^2\right],$$

$$F = K_1\left[(Fo - K_1 \tan t\alpha_1)/(K_1 + Fo \tan t\alpha_1)\right],$$

Where: $K_1 = \sqrt{2BC_1/A}$

$C_1 = [Go-(A/2B)Fo^2]$,

$\alpha_1 = (1/2)AK_1$,

and $t\alpha_1 < \pi/2$.

For the case where $Go < (A/2B)Fo^2$ the escort wins with $F_{final} = C_2$ and

$$G = C_2\left[\left\{(Fo + K_2 \tanh t\alpha_2)/(K_2 + Fo \tanh t\alpha_2)\right\}^2 - 1\right],$$

$$F = K_2[(Fo + K_2 \tanh t\alpha_2)/(K_2 + Fo \tanh t\alpha_2)],$$

where $K_2 = \sqrt{2BC_2/A}$,

$C_2 = [(A/2B)Fo^2 - Go]$,

and $\alpha_2 = (1/2)AK_2$.

D. REACTION FORCE EFFECTIVENESS

For purposes of this analysis it is assumed that in order for the reaction forces to be effective they must arrive before the predicted completion of the battle. If the initial escort size is such that the guerrilla might be expected to win the engagement then the arrival of reaction forces can prevent the annihilation of the escort and change the course of the battle. If the escort size is such that the escort would be expected to win then the arrival of reaction forces can reduce casualties. Also, if the guerrilla breaks contact, the reaction forces can pursue him almost immediately.

Reaction times are greatly increased by long load times and communications delays. If reaction forces are to be relied upon to defeat ambushes it appears that this "dead" time must be reduced in every way possible.

E. AN EXAMPLE OF REACTION FORCES AND AN ESCORT OF VARIOUS SIZES FOR A FIXED GUERRILLA FORCE.

In this example the following data has been used.

Go = 80

RF = 20 rounds per minute

RG = 20 rounds per minute

AEF1 = 1.5 sq. ft.

PF1 = .01

AG1 = 100 sq. ft.

Helo speed = 90 mph

Truck speed = 30 mph

Load Time and Communications Delays = 5 minutes

The size of the insurgent force (Go) was chosen because it seems to be representative of what might be expected in a convoy ambush. Smaller and larger size units can be used in the analysis if desired. The rates of fire (RF, RG) may be low for such weapons as the M-16 but twenty rounds per minute was used because this represents sustained fire by all personnel in the escort force. Single round area of effectiveness for friendly fire (AEF1) represents the target area actually occupied by one insurgent. The possible area of 100 sq. ft. which one insurgent may occupy (AG1) represents a ten by ten foot square in which the insurgent may be

located. The single shot kill probability for guerrilla fire (PG1) seems reasonable for the situation considered. The helicopter and truck speeds are representative of contemporary equipment. The aforementioned data was used in the computer program and the results are shown in the sample output which is included in the Appendix.

In Figure 15 the battle time for various size escorts and an eighty man insurgent force has been plotted. The percentage of the escort force which survives has also been plotted and it can be seen that in the area where the guerrilla is expected to win the percentage of the escort which survives is zero. The escort of size ninety-two represents the point at which equality occurs and has been labeled as the BREAK EVEN point. The computed battle time at this point approaches infinity but can be assumed to have some finite upper limit which is probably in the neighborhood of one hour.

When the size of the escort is less than the break-even size it can be seen that the battle time drops off rapidly. It should be remembered that the times which are plotted are for the total destruction of the escort. For escort sizes above the break-even size the battle times again drop off but the result for these engagements is that the guerrilla is defeated. Friendly casualties and survivors are also shown in Figure 15.

In Figure 16 the distances from which heliborne and truckborne reaction forces, using a five minute departure

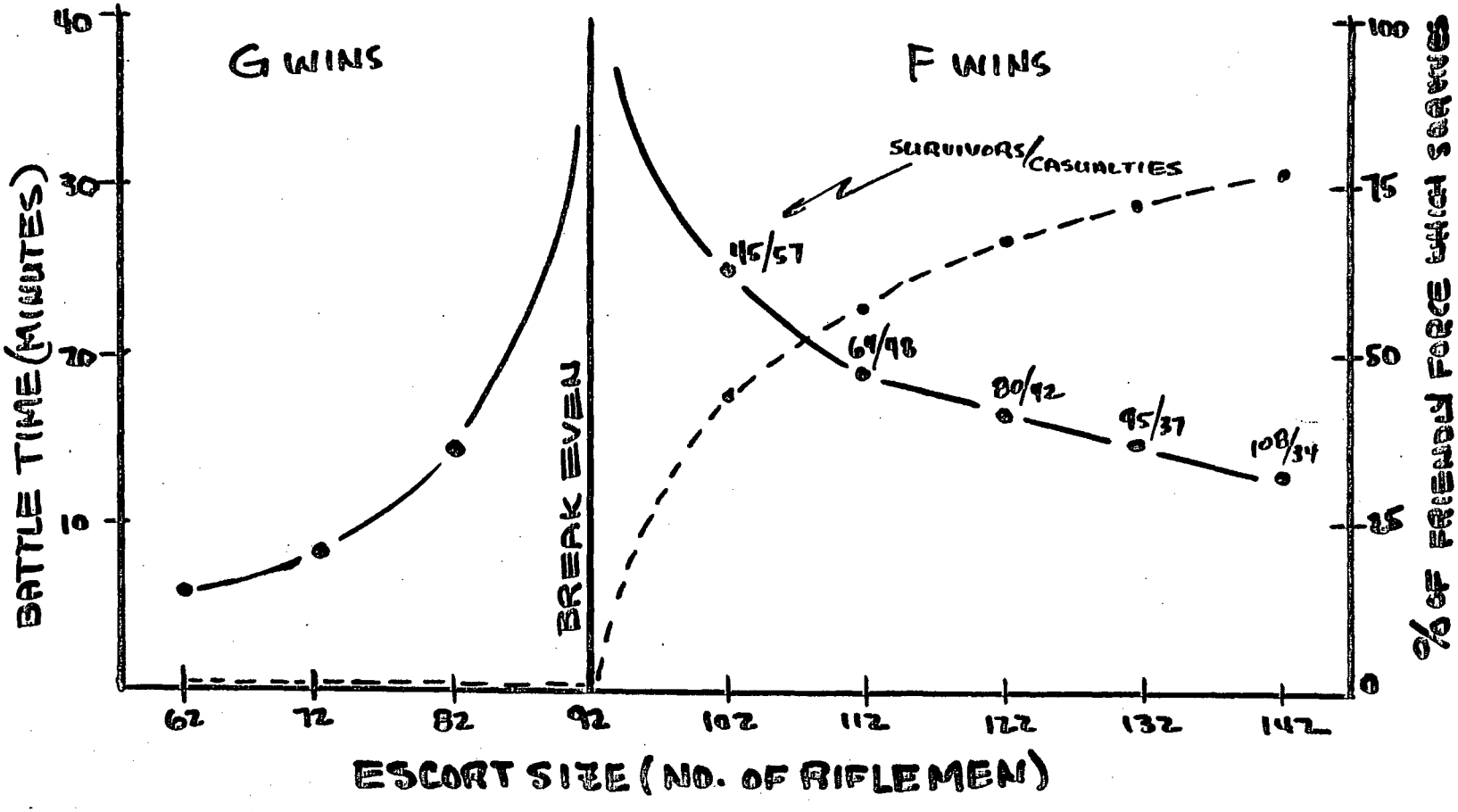

FIGURE 15

AN EXAMPLE OF THE TRADEOFF BETWEEN BATTLE TIME
AND ESCORT SIZE FOR AN INSURGENT FORCE OF EIGHTY RIFLEMEN

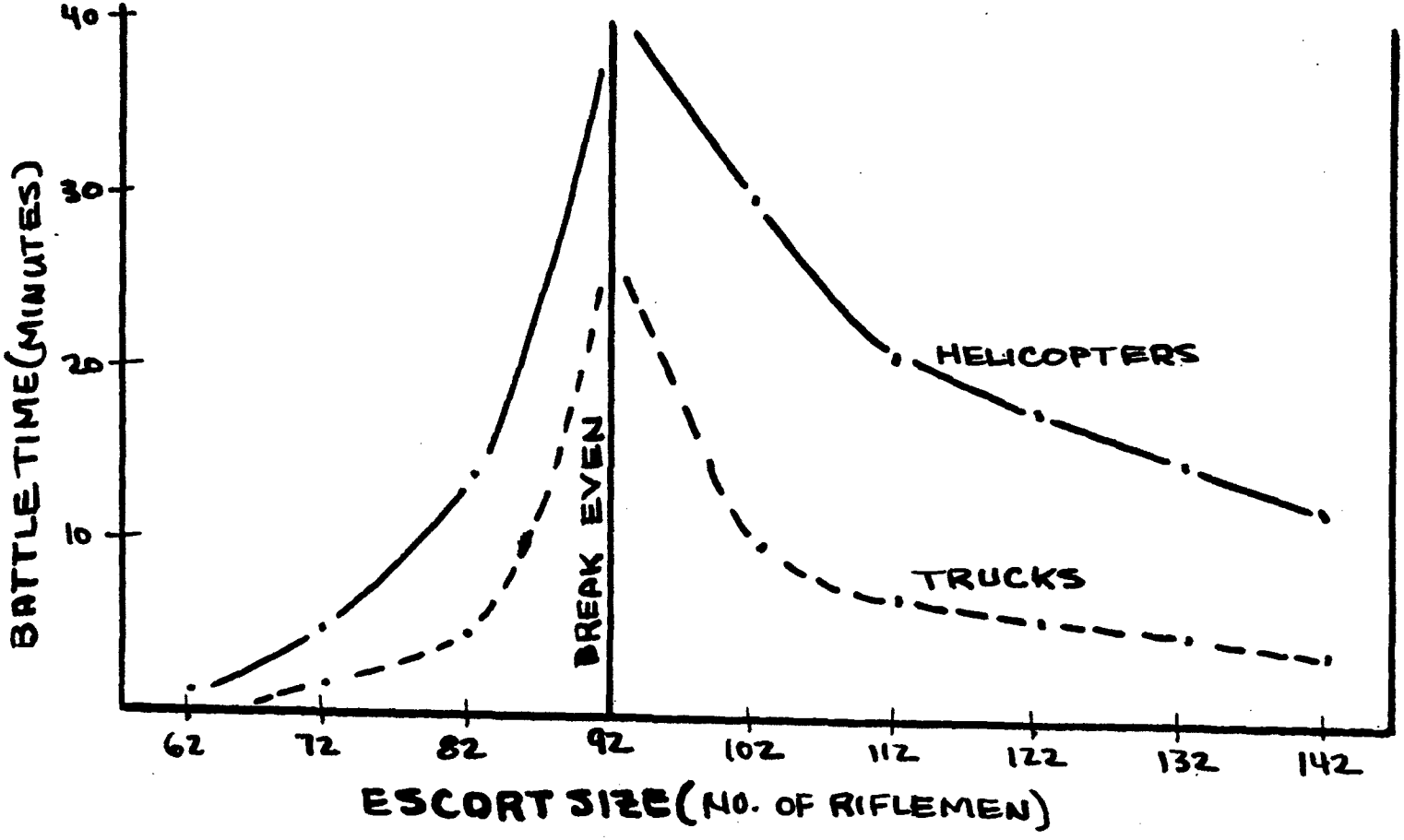

FIGURE 16

AN EXAMPLE OF THE TRADEOFF BETWEEN DISTANCE FROM AMBUSH SITE AND ESCORT SIZE FOR HELICOPTERS AND TRUCKS.

INITIAL INSURGENT FORCE OF EIGHTY RIFLEMEN

delay time, can operate have been plotted. These distances are based on the premise that reaction forces are of value only if they arrive before the battle is over.

The break-even escort size for a given size of guerrilla force, will probably be fairly well known in actual operations and it is unlikely that convoys would be moved with escorts much smaller than this break-even size. The guerrilla will probably not attack convoys which are escorted by forces of a size that can be expected to win in a short time. Consequently, large escorts may deter attacks or force the guerrilla to increase the size of units he uses for convoy ambushes. The counterinsurgent will not, in all probability, always have enough forces available to provide escorts large enough to deter the guerrilla from attacking.

In those areas where escort size must be at or below the break-even point the counterinsurgent may be forced to have reaction forces in airborne helicopters in order to meet the time requirements for effective reaction. Required reaction times are also reduced for large escorts because it can be expected that the insurgent will break contact if he sees he is losing, and he cannot be effectively pursued if reaction forces arrive too late.

In general, one can say that the battle time will fall off rapidly on either side of the break-even point and consequently the distances at which reaction forces can be positioned will also be decreased.

F. DISCUSSION AND RECOMMENDATIONS

Although the data used in the example may not correspond exactly to present operational data the form of the results do compare favorably with intuition. The model could possibly be enhanced by using some additional techniques. Perhaps the Lanchester model as presented could be used for the first few minutes of an engagement and then the square law could be applied to both sides. This would simulate the escort force taking cover. Another approach which might be useful would be to collect available empirical data on convoy ambushes and use the data for a computer simulation. The effects of artillery and other support weapons could then also be examined. Convoy size has not been considered here and this would certainly have some effect on the ability of the insurgent to take security forces under fire and the ability of the security forces to return fire. In red areas where convoys will probably be large, but few in number, the escort should be of a size well above the break-even point. This would provide some deterrent and give the convoy commander much more flexibility in the employment of his security forces. In yellow areas it can be expected that the traffic density will be greater and the convoys will be smaller than those in the red areas. The escorts in yellow areas will probably be smaller but should be at least as big as the break-even size if possible. Reaction forces can probably be designated to support more than one convoy due to the reduced expected frequency of attack by the

insurgent. This will tend to reduce the resource cost of a single convoy somewhat in comparison with a convoy of similar size moving in a red area.

The primary points that seem to stand out in this analysis are that if reaction forces are to be used they must be rapid and that the size of the escort must be at least as great as the break-even size if favorable results are to be achieved.

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

With the ever-increasing numbers of helicopters appearing on the modern battlefield it is possible that movement by truck in a hostile environment will someday become a thing of the past. That day, however, is still far away and therefore anything which can be done to make truck movements more successful should at least be of value in the foreseeable future.

Military operations of almost all types have been studied in some detail but route security operations seem to have been somewhat neglected. Anti-ambush techniques are taught in most ground-oriented military courses but the overall view of route security and the inherent problems have apparently escaped the detailed analysis given to other types of operations. Perhaps in the future more detailed analysis of past route security operations will be made which may lead to the adoption of better route security methods in the years to come.

Rainstorms, blown bridges or a change in emphasis by the insurgent can rapidly alter the forces required to provide security in a particular area. Planners of route security operations should consider, to whatever extent is feasible, the effects of weather, the routes traversed and the enemy capabilities and intentions so that they can build a flexible and responsive system. The route security problem is dynamic in nature and continual examination should be made of the constantly changing environment.

The possible ways in which convoys can be structured with regard to size and composition, the reasons for movement and the relative resource costs should be considered by both combat and logistic unit commanders. Expected reaction time for reaction forces which use different types of transport should be computed and the forces positioned so that their capabilities can be efficiently utilized. If the security resources are limited, which is usually the case, then it is even more important that they are used efficiently.

It appears that escort forces must be of a size which enables them to at least hold their own with any anticipated attacking force so that reaction forces have a reasonable amount of time in which to respond. When reaction forces are used they must have a means of high-speed transport or they will probably arrive too late to be of any value to the attacked convoy.

Drills should be conducted whenever possible for all route security forces so that when the need arises for their services, commanders will have reliable information on their expected effectiveness. These drills also give security forces a chance to iron out difficulties before they are required to perform.

With respect to future study several things come to mind which may be worthy of consideration.

Some form of manual war game could possibly be developed which would allow interested persons to observe the effects of route security decisions on mission accomplishment.

Experimentation by military units using different size convoys, security forces and aggressor units could provide valuable information for future use. Historical research of past encounters could probably provide additional data. Once some good empirical data is available a computer simulation could be used to study the effects of changes in the predominant elements of the problem. Chapter VI is a first step in this direction. A study to acquire more factual data would enhance use of models of this kind as would their modification to include the use of aircraft and artillery in route security.

If the enemy order of battle in a given area could be quantified and the disposition to attack described in some way then one could forecast the expected firepower threat to a moving element. From this one could predict, with some level of confidence, the security forces which would be required to provide an advantageous firepower position over the attacker and insure that the convoy would reach its destination.

Interesting work could also be done in the realm of cost-effectiveness studies for the various resource-mode of employment combinations. If, for example, the helicopter proved to be a cost-effective means for transporting escort troops it could influence the types and numbers of helicopters which are purchased in the future.

The surface has been scratched and some of the prominent elements of the route security problem have been identified. Several of the relationships have been examined,

but this is only a beginning. It is hoped that those who read this paper will share the author's enthusiasm and undertake the task of going another step forward so that ultimately the forces in the field can be provided with the best possible route security.

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APPENDIX

The following programs were written in Fortran 63 and were run on the CDC 1604 computer. Comment cards are included to explain the programs. All variable names are six letters or less and it should not be difficult to change the program to Fortran IV for use on the IBM 360 series of computers. Sample output is also shown.

```
-COOP,,ROGERS RP,S/1S/2S,5,5000,4.      CHAP61
-FTN,L,E.
      PROGRAM CHAP61
C          THIS PROGRAM WAS WRITTEN TO ENABLE ONE TO DO SOME
C          WORK WITH THE LANCHESTERS EQUATIONS PROPOSED BY
C          DEITCHMAN IN THE NOV-DEC 62 ISSUE OF JORSA.  THE
C          NOTATION USED IS SIMILAR AND WHERE IT IS DIFFERENT
C          IT IS EXPLAINED  BATTLE TIMES AND DISTANCES FOR
C          HELIBORNE AND TRUCKBORNE REACTION FORCES ARE
C          COMPUTED FOR DIFFERENT SIZE CONVOY ESCORTS.
    1 READ 2000,G0,RF,RG,AEF1,PG1,AG1,FLAG
 2000 FORMAT(7F10.5)
C          G0   = INITIAL GUERRILLA STRENGTH
C          RF   = FRIENDLY RATE OF FIRE FOR SINGLE WEAPON
C          RG   = GUERRILLA RATE OF FIRE FOR SINGLE WEAPON
C          AEF1= AREA OF EFFECTIVENESS FOR A FRIENDLY ROUND
C          PG1  = KILL PROBABILITY FOR A GUERRILLA ROUND
C          AG1  = AREA WHICH ONE GUERRILLA MAY OCCUPY
C          FLAG= USED TO STOP THE PROGRAM.  PUT ON LAST DATA
C                CARD ONLY.  SEE STATEMENT NUMBER 15.
      AGT=AG1 * G0
      A = (RF * AEF1)/AGT
      B= RG * PG1
      B2A= (B*2.)/A
      AB2= 1.0/B2A
      BKEV= SQRTF(G0 * B2A)
C          BKEV= ESCORT SIZE REQUIRED FOR A DRAW. I.E.
C                FRIENDLY SIDE WINS HALF THE TIME AND ALL BUT
C                ONE MAN ARE LOST.
      PRINT 2001,G0,BKEV,RF,RG,AEF1,PG1,AG1,AB2
 2001 FORMAT(1H1,19X,18HGUERRILLA FORCE = ,F5.0,5X,
     123HESCORT TO BREAK EVEN = ,F5.0,/,20X,5HRF = ,F5.0,2X,5HRG = ,F5.0
```

```
     2,2X,7HAEF1 = ,F4.1,2X,6HPG1 = ,F5.3,2X,6HAG1 = ,F5.0,/,
     320X,7HA/2B = ,F6.4,/,20X,
     432HESCORT LESS THAN BREAK EVEN SIZE)
C          THE FOLLOWING IS USED FOR THE CASE WHEN G0 IS
C          GREATER THAN (A/2B)*F0*F0 AND THE GUERRILLA WINS.
C          FOUR VALUES OF F0, WHICH IS THE ESCORT SIZE ARE
C          USED AND TIME UNTIL F0 IS REDUCED TO ZERO IS COM-
C          PUTED. THIS IS DONE TO CHECK REACTION FORCE FEASI-
C          BILITY.  HELO AND TRUCK DISTANCES ARE ALSO COMPU-
C          TED USING THIS INFO.
       F0=BKEV-30.
       I=1
       GO TO 5
     2 F0=BKEV-20.
       I=2
       GO TO 5
     3 F0=BKEV-10.
       I=3
       GO TO 5
     4 F0=BKEV-1.0
C          USED TO REDUCE F0 SLIGHTLY SO THAT THE REQUIRED
C          CONDITION HOLDS
       I=4
       GO TO 5
     5 C1 = G0 - (AB2 * F0 * F0)
       VK1= SQRTF(B2A * C1)
       ALPHA1=.5 * A * VK1
       TAU=(ATANF(F0/VK1))/ALPHA1
       DHELO =(TAU - 5.0) * 1.5
       DTRUCK=(TAU - 5.0) * 0.5
C          5.0 IMPLIES 5 MINUTE LOAD TIME AND COMMUNICATION
C          DELAY. THE 1.5 IS MILES PER MINUTE FOR A 90 MPH
```

```
C          HELICOPTER. THE .5 IS MILES PER MINUTE FOR A 30
C          MPH TRUCK.
       PRINT 2002,F0,TAU,DHELO,DTRUCK
 2002 FORMAT(20X,5HF0 = ,F5.0,2X,6HTAU = ,F3.0,16X,8HDHELO = ,F3.0,2X,
     19HDTRUCK = ,F3.0)
       GO TO (2,3,4,6),I
C          USED TO RETURN TO DIFFERENT VALUES OF F0
    6 PRINT 2003
 2003 FORMAT(/20X,35HESCORT GREATER THAN BREAK EVEN SIZE)
C          THE FOLLOWING IS USED FOR THE CASE WHEN GO IS LESS
C          THAN (A/2B)*F0*F0 AND THE FRIENDLY SIDE WINS.
C          FIVE VALUES OF F0 ARE USED AND A PRINTOUT IS PRO-
C          VIDED FOR EACH F0 GIVING THE STRENGTH OF BOTH SIDES
C          FOR TIMES UP TO ONE HOUR. HELO AND TRUCK DISTANCES
C          ARE ALSO COMPUTED.
    7 F0=BKEV+10.0
       J=1
       GO TO 12
    8 F0=BKEV+20.0
       J=2
       GO TO 12
    9 F0=BKEV+30.0
       J=3
       GO TO 12
   10 F0=BKEV+40.0
       J=4
       GO TO 12
   11 F0=BKEV+50.0
       J=5
       GO TO 12
   12 C2=(AB2*F0*F0)-G0
       VK2=SQRTF(B2A * C2)
```

```
      ALPHA2= .5 * A * VK2
      PRINT 2004,F0
 2004 FORMAT(20X,5HF0 = ,F5.0,18H  TAU =         F =,
     14X,26HG =  DHELO =       DTRUCK =)
      DO 13 L=1,60,2
      TAU=L
      V1 = F0+VK2 * TANHF(TAU * ALPHA2)
      V2 = VK2 +F0* TANHF(TAU * ALPHA2)
      V3 = V1/V2
C          V1,V2,V3 USED ONLY FOR PROGRAMMING CONVENIENCE.
C          GUERRILLA FORCE SIZE COMPUTATION.
      G =C2*(V3*V3-1.0)
C          FRIENDLY FORCE SIZE COMPUTATION.
      F =VK2*V3
      DHELO=(TAU-5.0) * 1.5
      DTRUCK=(TAU-5.0)*0.5
      PRINT 2005,TAU,F,G,DHELO,DTRUCK
 2005 FORMAT(38X,F3.0,2X,F5.0,2X,F5.0,10X,F3.0,11X,F3.0)
      IF(G-.5)14,14,13
C          USED TO GET OUT OF THE DO LOOP WHEN THE GUERRILLA
C          FORCE IS REDUCED TO ZERO.
   13 CONTINUE
   14 GO TO(8,9,10,11,15),J
C          USED TO RETURN FOR DIFFERENT VALUES OF F0.
   15 IF(FLAG-5.0)1,88,1
   88 CONTINUE
      END
         END
         FINIS
-EXECUTE.
```

SAMPLE DATA CARDS

G0	RF	RG	AEF1	PG1	AG1	FLAG
80.	20.0	20.0	1.5	.01	100.0	
30.	20.0	20.0	.5	.01	100.0	
80.	20.0	20.0	.5	.1	100.0	
80.	20.0	20.0	.5	.01	100.0	
150.	20.0	20.0	.5	.01	100.0	5.0

GUERRILLA FORCE = 80 ESCORT TO BREAK EVEN = 92
RF = 20 RG = 20 AEF1 = 1.5 PG1 = .010 AG1 = 100
A/2B = .0094
ESCORT LESS THAN BREAK EVEN SIZE

F0 =	62	TAU =	6			DHELO =	0	DTRUCK = 0
F0 =	72	TAU =	8			DHELO =	5	DTRUCK = 2
F0 =	82	TAU =	14			DHELO =	14	DTRUCK = 5
F0 =	91	TAU =	56			DHELO =	76	DTRUCK = 25

ESCORT GREATER THAN BREAK EVEN SIZE

F0 =	102	TAU =		F =	G =	DHELO =		DTRUCK =
			1	89	56		-6	-2
			3	72	31		-3	-1
			5	63	19		0	0
			7	57	12		3	1
			9	53	8		6	2
			11	50	5		9	3
			13	48	4		12	4
			15	47	3		15	5
			17	46	2		18	6
			19	46	1		21	7
			21	45	1		24	8
			23	45	1		27	9
			25	45			30	10
F0 =	112	TAU =		F =	G =	DHELO =		DTRUCK =
			1	99	54		-6	-2
			3	84	27		-3	-1
			5	75	15		0	0
			7	71	9		3	1
			9	68	5		6	2
			11	66	3		9	3
			13	66	2		12	4
			15	65	1		15	5
			17	65	1		18	6
			19	64			21	7
F0 =	122	TAU =		F =	G =	DHELO =		DTRUCK =
			1	109	52		-6	-2
			3	95	24		-3	-1
			5	88	12		0	0
			7	84	6		3	1
			9	82	3		6	2
			11	81	2		9	3
			13	81	1		12	4
			15	81	1		15	5
			17	80			18	6
F0 =	132	TAU =		F =	G =	DHELO =		DTRUCK =
			1	120	50		-6	-2
			3	106	22		-3	-1
			5	100	10		0	0
			7	97	5		3	1
			9	96	2		6	2
			11	95	1		9	3
			13	95	1		12	4
			15	95			15	5
F0 =	142	TAU =		F =	G =	DHELO =		DTRUCK =
			1	130	48		-6	-2
			3	117	19		-3	-1
			5	112	8		0	0
			7	110	4		3	1
			9	109	2		6	2
			11	109	1		9	3
			13	108			12	4

```
-COOP,,ROGERS RP,S/1S/2S,5,5000,4.      CHAP62
-FTN,L,E.
      PROGRAM CHAP62
C          THIS PROGRAM CAN BE USED WHEN IT IS DESIRED TO
C          CHECK THE EFFECT OF VARIOUS VALUES OF A/2B. THE
C          ONLY DATA REQUIRED IS A/2B AND 2B. ALL CARDS BELOW
C          FORMAT STATEMENT 2001 IN THE PREVIOUS PROGRAM ARE
C          THE SAME.
    1 READ 2000,G0,AB2,B2,FLAG
 2000 FORMAT(4F10.0)
      B2A=1.0/AB2
      BKEV=SQRTF(G0*B2A)
      A=AB2*B2
      PRINT 2001,G0,BKEV,AB2,B2
 2001 FORMAT(1H1,19X,18HGUERRILLA FORCE = ,F5.0,5X,
     123HESCORT TO BREAK EVEN = ,F5.0,/,
     220X,7HA/2B = ,F6.4,2X,5HB2 = ,F6.3,
     3/,2 X,32HESCORT LESS THAN BREAK EVEN SIZE)
```

SAMPLE DATA CARDS

G0	AB2	B2	FLAG
80.	.0094	.4	
30.	.0083	.4	
80.	.0003	4.0	
80.	.0031	.4	
150.	.0017	.4	5.0

GUERRILLA FORCE = 80 ESCORT TO BREAK EVEN = 92
A/2B = .0094 B2 = .400
ESCORT LESS THAN BREAK EVEN SIZE

F0 =	62	TAU =	6			DHELO =	0	DTRUCK = 0
F0 =	72	TAU =	8			DHELO =	5	DTRUCK = 2
F0 =	82	TAU =	14			DHELO =	14	DTRUCK = 5
F0 =	91	TAU =	56			DHELO =	76	DTRUCK = 25

ESCORT GREATER THAN BREAK EVEN SIZE

F0 =	102	TAU =		F =	G =	DHELO =		DTRUCK =
			1	89	56		-6	-2
			3	72	31		-3	-1
			5	63	19		0	0
			7	57	12		3	1
			9	53	8		6	2
			11	50	5		9	3
			13	48	4		12	4
			15	47	3		15	5
			17	46	2		18	6
			19	46	1		21	7
			21	45	1		24	8
			23	45	1		27	9
			25	45			30	10
F0 =	112	TAU =		F =	G =	DHELO =		DTRUCK =
			1	99	54		-6	-2
			3	84	27		-3	-1
			5	75	15		0	0
			7	71	9		3	1
			9	68	5		6	2
			11	66	3		9	3
			13	66	2		12	4
			15	65	1		15	5
			17	65	1		18	6
			19	64			21	7
F0 =	122	TAU =		F =	G =	DHELO =		DTRUCK =
			1	109	52		-6	-2
			3	95	24		-3	-1
			5	88	12		0	0
			7	84	6		3	1
			9	82	3		6	2
			11	81	2		9	3
			13	81	1		12	4
			15	81	1		15	5
			17	80			18	6
F0 =	132	TAU =		F =	G =	DHELO =		DTRUCK =
			1	120	50		-6	-2
			3	106	22		-3	-1
			5	100	10		0	0
			7	97	5		3	1
			9	96	2		6	2
			11	95	1		9	3
			13	95	1		12	4
			15	95			15	5
F0 =	142	TAU =		F =	G =	DHELO =		DTRUCK =
			1	130	48		-6	-2
			3	117	19		-3	-1
			5	112	8		0	0
			7	110	4		3	1
			9	109	2		6	2
			11	109	1		9	3
			13	108			12	4

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13. ABSTRACT

The problem of providing security for ground lines of communications in the counterinsurgency environment is examined. Several types of forces and modes of employment are considered and analyzed in order to determine their feasibility and desirability. Recommendations are made for resource allocation in areas which have different insurgent threat levels. Some economic and political factors which affect route security are mentioned.

A comparison, using Lanchester's equations, is made of the reaction and escort modes of employment for infantry forces providing security to a truck convoy. Graphs are provided which show the effects of time on reaction force feasibility.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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